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THE EFFECT OF PROGRAMMED INSTRUCTION IN SPECIAL SKILLS DURING THE PRESCHOOL PERIOD ON LATER ABILITY PATTERNS AND ACADEMIC ACHIEVEMENT.

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GROUPS OF SOUTHERN, RURAL, PRESCHOOL CHILDREN, APPROXIMATELY HALF OF WHOM COULD BE CONSIDERED TO BE CULTURALLY DEPRIVED, WERE USED TO TEST FOUR POSSIBILITIES. THESE WERE THAT (1) INTELLIGENCE MIGHT BE MODIFIABLE, (2) INTELLIGENCE COULD BE VIEWED NOT ONLY AS A SINGLE BEHAVIORAL DOMAIN, BUT ALSO AS A NUMBER OF SUCH DOMAINS, (3) CULTURAL DEPRIVATION COULD IMPLY LOW LEVELS OF INTELLECTIVE FUNCTIONING WHICH RESULT NOT ONLY FROM LACK OF PRIOR STIMULATION BUT ALSO FROM INADEQUATE DISCRIMINATIVE TRAINING, AND (4) TRAINING MIGHT PROFITABLY BE GIVEN IN THE VARIOUS INTELLECTUAL REPERTOIRES IF APPROPRIATE PROGRAMS COULD BE CONSTRUCTED AND IF PRECISE REINFORCING CONTINGENCIES WOULD BE ARRANGED AND CONTROLLED BY MEANS OF AUTOMATED DEVICES. THE RESEARCH WAS DIRECTED BY FIVE QUESTIONS DERIVED FROM THE POSSIBILITIES CONSIDERED. THE CONCLUSIONS WERE--(1) ONLY QUALIFIED ANSWERS TO THOSE QUESTIONS CAN BE GIVEN, (2) THE DATA GATHERED RAISED AS MANY QUESTIONS AS WERE ANSWERED, AND (3) THE POSSIBILITIES CONSIDERED WERE ONLY PARTIALLY SUPPORTED. (TC)

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PREFACE

The research to be described in this report is based in part on some earlier research which was conducted by Dr. James Holland, Dr. B. F. Skinner, and me during the summers of 1960 and 1961. At that time we were attempting to develop several different discriminative repertoires in retarded children by means of matching-to-sample presenters and programs which were similar in many respects to those used in the present research. I am indebted to Drs. Holland and Skinner for the early development of this technique and for the instruction they gave me in its use.

The present research was to a large extent carried out as a group enterprise, and without the assistance of Drs. Earl Baughman and Grant Dahlstrom and their staff, it could not have been conducted. As early as 1960, Baughman and Dahlstrom began to make contacts and to establish rapport with school officials, teachers, parents, and children in northern Orange County. In 1961 they began their own project, the purpose of which was to study intellective, social, and personality development in southern rural children. It was in large measure because of their work in this geographical area that I was able to establish the two kindergartens and two instructional laboratories at Efland, North Carolina in the fall of 1962.

All test administration during the academic years of 1962-63 and 1963-64 was carried out by examiners on the Baughman-Dahlstrom staff, and their salaries were paid from Baughman-Dahlstrom project funds provided by N.I.M.H. Most of the same examiners did the testing during

the academic years of 1964-65 and 1965-66. Their salaries, however, were paid from Office of Education funds. In general, the examiners were excellent, and I am indebted to Drs. Baughman and Dahlstrom for assembling them and making them available to my project. My thanks also go to the examiners themselves. These include Sophie Martin, Barbara Nixon, Rosemary Funderburg, Eva Ray, Anne Spitznagel, and Musia Lakin.

A number of colleagues have been especially helpful in other phases of the research. Mrs. Kathleen Fink was extremely helpful in preparing the matching-to-sample programs. The typewriter programs were in large measure prepared by Frank Graham, Linda Motley, Robert Rudolph, Kathryn Calhoon, Mary Daniel, and Margo Murphy. During the first three years Dr. John DeLorge and Dr. Eugene McDowell carried out almost all of the matching-to-sample training. During the fourth year Joseph Walton, Robert Rudolph, and Kathryn Calhoon conducted the typewriter training. I am also indebted to Mr. Paul Carr, Dr. James Godfrey, and Dr. Marcus Waller. Mr. Carr as Superintendent of the Orange County Public School System was extremely supportive and helpful administratively. Dr. Godfrey was also generous with his administrative assistance. On at least two occasions his action saved the project from being terminated prematurely. Dr. Waller was very helpful in a number of ways. He aided greatly, for example, in re-designing and building the present matching-to-sample presenters and related equipment. Dr. Waller was also my constant advisor on technical matters.

Finally, Dr. Lyle Jones and Dr. Douglas Schoeninger made many helpful suggestions in regard to the analyses of the data, and I wish to thank them for their assistance.

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PROBLEM

The question of modifiability of intelligence is once more a pertinent one. It is no longer only a theoretical question, however, but is one which has immediate and practical implications. Great concern is now being expressed over economic poverty and its twin evil, cultural deprivation. Remedial action is being taken at all age levels, but greatest interest centers on the culturally-deprived preschool child and methods for raising his level of intellective functioning.

The question, of course, is not completely divorced from theory. Hunt (1961) points to a changing conception of intelligence. This new conception is that intelligence is not constant, nor is it necessarily doomed to develop in a fixed, unmodifiable way. He cites data to support the contention that intelligence and intellective development can be modified by means of environmental events.

There is another changing conception of intelligence which has important implications. This is that intelligence need no longer be viewed as a single unidimensional entity capable of being described by a single measure or index, e.g. the I.Q., but might be described multi-dimensionally. If this proposition were formulated in behavioral terms, intelligent behavior would be conceived of not as a single class, but rather a number of different classes or repertoires of behavior, and to make meaningful comparisons among people in regard to intelligence, one would sample and compare each of these repertoires.

The question which now arises is how might one go about modifying the intellective repertoires of various kinds of people, particularly of preschool children? One would certainly make use of nursery school and kindergarten teachers and give instruction in the verbal, perceptual, and numerical repertoires by direct verbal instruction and by example. Skinner (1961a, 1961b), however, points out that many children move into adulthood with largely undeveloped repertoires because the environment and the traditional educational agents are often unable to supply appropriately reinforcing contingencies. Thus, children do not necessarily grow up in impoverished environments in the sense that they are exposed to a restricted or inadequate range of stimuli, but in the sense that they never experience many of the contingencies necessary for the development of the fine discriminations entailed in intellective repertoires. This occurs because the contingencies are too subtle and too difficult for many parents and teachers to arrange and control. To remedy this situation, Skinner suggests the use of relatively simple teaching machines.

Machines are, of course, only part of the answer. Used in conjunction with them must be properly conceived, coherently arranged programs. Such programs must not only effect intellective improvement during the preschool period, but must also shape and strengthen those skills or abilities which are involved in the more global academic behaviors developed later in school. The general problem then is to determine whether or not programs and automated procedures can be developed which, when used in conjunction with normal kindergarten instruction, will produce greater increases in the proficiency of preschool children in certain basic intellective skills than will kindergarten experience alone. The skills to be investigated include verbal comprehension, perceptual analysis, quantitative thinking, and spatial visualization. A second aspect of the problem is to determine whether or not the effects of the special preschool training in these basic skills generalize beyond the programs themselves or existing tests of these abilities and actually augment the later learning of academic subjects in school.

OBJECTIVES

In the preceding section, alternative formulations of intelligence and cultural deprivation were considered. Four major points were made. These were: (1) that intelligence might be modifiable, (2) that it could be viewed not only as a single behavioral domain, but also as a number of such domains, (3) that cultural deprivation could imply low levels of intellective functioning which result not only from lack of prior stimulation but also from inadequate discriminative training, and (4) that training might profitably be given in the various intellectual repertoires if appropriate programs could be constructed and if precise reinforcing contingencies would be arranged and controlled by means of automated devices.

It is the general purpose of this research to test experimentally the feasibility of these alternative formulations with groups of southern, rural, preschool children, approximately half of whom could be considered to be culturally deprived. The research was directed by five specific questions, and finding empirical answers to these questions was the objective of the research. The questions are the following:

1. Can Stanford-Binet I.Q.'s and patterns of abilities as measured by the Primary Mental Abilities (P.M.A.) test be changed by kindergarten experience?

2. Will programmed discriminative training given in conjunction with normal kindergarten experience produce greater changes in Stanford-Binet I.Q. and P.M.A. quotients than kindergarten experience alone?

3. How persistent are the changes produced by kindergarten experience and by kindergarten experience plus the special instruction?

4. Are the changes produced related to original level of intellective functioning?

5. Are the effects of kindergarten experience and of kindergarten experience plus the special programmed instruction sufficiently general in nature to influence later academic performance as reflected by school grades and by scores made on the Stanford Achievement Test?

RELATED RESEARCH

The relative importance of nature and nurture in the development of intelligent behavior is a controversy of long standing. Excellent reviews of this controversy, its theory, and its research have been published by a number of investigators, including Jones (1946, 1954), Anastasi (1958), Hunt (1961), and Fowler (1962). Research on the role of environmental influences typically has entailed assessing one of the following interventional procedures: (1) placing institutionalized children or children from intellectually "poor" homes in foster homes, (2) giving training on intelligence test items or similar materials, and (3) giving broader social and cognitive training by means of nursery school and kindergarten instruction.

The efficacious effects of foster home placement on intellective development are well described by Burks (1928), Freeman, Holzinger, and Mitchell (1928), Leahy (1935), Skodak (1939), Skeels (1940, 1965) and Skodak and Skeels (1945, 1949). Some of the problems inherent in this type of research are discussed by Jones (1946). Despite these difficulties, the magnitude and direction of the effects, even in the face of complications which might be expected to attenuate them, are impressive and seem to justify the contention that environmental experience should be viewed as an important determiner of intelligence.

The two remaining interventional procedures entail the use of better controlled,or at least more completely specifiable procedures. The first of these, i.e. giving special coaching on specific test items, has been carried out by Greene (1928) and by Casey, Davidson, and Harter (1928). The effects of such coaching, especially that carried out by Greene, seem surprisingly large and persistent. This was found to be true in some cases even when training was given on material similar to the test material rather than on the test itself.

It seems surprising that such research was conducted for the most part to determine to what degree repeated testing (of which this was an extreme case) could contaminate intelligence test scores. Indeed, data cited by Thorndike (1923), Lincoln (1935), and Adkins (1937) do show that I.Q. gains occur as a function of repeated testing. There seems to be little or no evidence, however, that such procedures were investigated to determine whether or not they might have salutory effects on cognitive development generally or on later academic achievement. Today such activities and materials constitute a major part of readiness training, e.g. Thelma G. Thurstone's Learning to Think Series (1947, 1948, 1949).

A final procedure entails giving broad training, e.g. social and motivational as well as intellective, by means of nursery schools and kindergartens. The procedure here seems to be continuous with that of the second, i.e. specific training on intelligence tests or on material similar to them, and present-day nursery school and kindergarten activities often include such training. The history of research on the effects of nursery school or kindergarten experience on intellectual development, however, more closely parallels that of the foster home procedure, perhaps because many of the same investigators are involved. Early studies by Woolley (1925) and by Barrett and Koch (1930) suggested that preschool experience has a favorable effect on intellectual development. Research conducted by Hildreth (1928), Goodenough (1928), and Kawin and Hoefer (1931), however, yielded negative findings. During the late 1930's and early 1940's, Wellman and her associatesreported a number of studies which yielded data supporting the contention that nursery school and kindergarten experience could favorably influence the level of intellectual functioning. These include Skeels, Updegraph, Wellman, and Williams (1939), Wellman (1938, 1943, and 1945) and

Wellman and McCandless (1946).

The findings of this group were criticized severely by other investigators (e.g. Goodenough (1939, 1940), Goodenough and Mauer (1940), and McNemar (1940)) and as a consequence the frequency with which later research of this kind was conducted was greatly reduced. It was, however, the highly controversial research of Schmidt (1946) and Kirk's (1948) devastatingly critical review of her report which for all practical purposes rendered such research extinct for approximately ten years. Interestingly enough, it was Kirk himself (1958, 1962) and his colleagues (e.g. Gallagher (1963)) who helped resurrect research on the effects of early training.

It is difficult to say what really brought about a renewed interest in the area. Certainly the 1954 Supreme Court decision was important in bringing unequal educational and economic opportunities to the attention of the nation as a whole. Great concern has developed over one of the consequences of such inequities, namely cultural impoverishment, and it is this which seems to have generated new research on the effects of environmental influences on intellectual development.

As one might expect, much of the interest centers on the culturally deprived child and how to rehabilitate him. Since 1963 a number of excellent collections of papers have been published on this and related topics. These include A. H. Passow's Education in depressed areas (1963), Compensatory education for cultural deprivation by Bloom, Davis, and Hess (1965), a collection by Frost and Hawkens entitled

The disadvantaged child (1966), Hechinger's Pre-school education today (1966), and a three-volume collection by Webster entitled The disadvantaged learner (1966). These collections by no means contain all the articles written in this general area, but they do accurately reflect the type of thinking and research now going on.

A survey of this literature suggests that it is directed toward answering three general questions. These are: (1) who are the culturally disadvantaged, (2) how do they think, learn, or behave in general, and (3) what sorts of learning and motivational influences must be brought to bear in order to improve their condition?

In regard to the first question, several rather clear characteristics emerge. Della-Dora (1962, 1963), Havinghurst (1964), and Witmer (1964) all agree that the culturally disadvantaged are for the most part the economically deprived. They usually hold the lowest paying jobs, reside in submarginal housing, often have improper diets, and frequently suffer from inadequate medical attention. In addition, although cultural deprivation can and does exist in all races, in all geographical locations, and with all kinds of family structures, it occurs more frequently under some conditions than others. A higher proportion of non-whites than whites, for example, are culturally deprived. Similarly, there is a higher percentage (though not a higher absolute frequency) of cultural deprivation in rural than in urban areas. In keeping with this, there is a higher proportion in the South than the North, and finally, cultural deprivation seems to occur more frequently in homes where the family is headed by a female instead of a male.

Next, what are the behavioral and motivational characteristics of the culturally disadvantaged? Many authors have suggested answers. Included among these are Ausubel (1965a, 1965b), Deutsch (1963a, 1963b, 1965, 1966), Hess (1964, 1965), and Reissman (1962, 1963a, 1963b, 1964). They point out that the culturally disadvantaged child is usually slow, concrete, and has less well-developed language, perceptual, and memory skills. Such a child may be unable to sustain attention; he lacks environmental information; and he is often unable to use an adult as a source of information. Such a child's motivation for school is often low, and problems of discipline frequently arise.

Finally, what must be done to improve the culturally-deprived child's condition? All authors seem to agree that perceptual, memoric, attentional, and verbal skills must be developed. The child must be exposed to a wide variety of environmental events. Stories and other verbal materials must be adjusted to the child's level and background. Because he is so concrete and interested in the here and now, his introduction to more abstract concepts must be delayed. Hunt (1961, 1964, 1966) suggests that early motivation might be lost if the child's behavior does not provide a degree of incongruity which is attractive. Ausubel (1963) also suggests that intrinsic motivation might be useful. The logic of this procedure is that the culturally deprived child's motivation for learning will increase as he discovers that he can learn. All authors point out that the child must be respected. The teacher must in no way suggest that she does not expect high level performance, and she must not respond differentially to him because of his social class. Both Sexton (1961) and Clark (1963) have spoken to this issue. Finally, the families of the children must be stimulated, and better understanding and rapport must be established between teachers and parents.

During the past ten years a great many research and remedial projects have come into being. Among these are the Higher Horizons Project and the Great Cities Project. These projects vary in their approaches. Some involve working with preschool children; others entail enriching primary and secondary grade curricula; finally, others involve special teacher training or working with parents. Because the research to be described in this report is concerned exclusively with the effects of special preschool procedures, many of the other studies are not directly relevant here. Moreover, of the large number of preschool studies now underway (Hess (1965b) lists 121 compensatory educational projects which in some way involve preschool children), few have reported their results. A survey of those who have, suggests that the most relevant are those conducted by Gray and Klaus (1965) in Murfreesboro, Tennessee, by Weikart, et al (1964) in Ypsilanti, Michigan, by Bereiter (1965, 1966) at the University of Illinois, and by Blatt and Garfunkel (1966) at Boston University.

Gray and Klaus worked with preschool Negro children from families having yearly incomes of less than $3000. The children were given intensive training during the summer and had weekly visitations by the teachers during the rest of the year. One experimental group which went through two summers of training showed a gain of nine I.Q. points (the initial Stanford-Binet I.Q. was 86; the final was 95). A second group having only one summer's training gained from a mean Stanford-Binet I.Q. of 91 to one of 96. The two control groups showed mean losses of from four to six points. Differential gains on the Illinois Test of Psycholinguistic Abilities (I.T.P.A.) were also reported. All data reported were obtained during the preschool period; no changes which occurred after the children entered school were reported.

Bereiter (1965) reports gains on the I.T.P.A. and on the Stanford-Binet made by 15 disadvantaged Negro children. The children were given training by direct verbal instruction in language, reading, and arithmetic. Stanford-Binet I.Q.'s increased from a mean of 93.7 to one of 100.4 over a six-month period (December to June). Impressive gains were also reported for several of the subtests of the I.T.P.A. No control group data were reported.

Weikart, _et_ _al_ (1964) using three- and four-year-old Negro children report large differential gains on the Stanford-Binet during the first preschool year, but not during the second. Thus in what Weikart calls Wave 0, the experimental children gained 12.8 I.Q. points (from 78.4 to 91.1) while the control group gained 7.2 (from 75.0 to 82.2). During the second year, however, the experimental group lost 2.2 points while the control group gained 2.4. Waves 1 and 2, which were composed of children who were three years old when they entered the experiment, showed similar trends. Thus, during the first year the experimental and control changes for Wave 1 were 11.5 (from 79.1 to

90.6) and -0.5 (from 78.3 to 77.8) respectively. During the second they were -1.7 and 2.3 respectively. Only first year data were reported for Wave 2. The mean changes for that year were 20.4 (from 80.5 to 100.9) for the experimental children and 3.5 (from 79.4 to 82.9) for the control.

Blatt and Garfunkel (1965) conducted a very carefully controlled experiment on preschool groups composed of both Negro and white children. The mean C. A. of the children at the start of the experiment was 3.2 years. Blatt and Garfunkel found that the experimental groups showed increases in Stanford-Binet I.Q., but the control group showed similar gains. Thus the four successive mean I. Q. scores obtained over the three-year period from the experimental group were 92.6, 99.1, 97.7, and 97.7. For the control group the mean I. Q. scores were 89.2, 91.9, 95.4, and 96.3. Because the differences were nonsignificant, Blatt and Garfunkel did not examine differences among experimental groups.

In general the data reported in these studies like those conducted during the 1930's and 1940's suggest that I. Q. increases can be produced through the intervention of intensive preschool instruction. The statement must be qualified, however, to account for negative instances. Gains in I.Q. are usually easier to produce at an early age than at a somewhat older one. They are also more readily produced if the initial I.Q. score is in the range of 75 to 80. Bereiter's study might supply the one exception to this, but unfortunately he does not report the data of a control group. Finally, differential gains produced by early preschool experience often disappear even when preschool training is continued.

A survey of the experimental procedures indicates that most investigators used several tests, a number of which were composed of subtests which yielded independent scores. This appears to be an important new trend, perhaps reflecting increasing disenchantment with a single index of intellectual functioning. It also perhaps reflects an increased interest in behavior and behavioral repertoires *per se*.

Only one study, however, that by Blatt and Garfunkel, reports the use of what might be called an automated technique in conjunction with other preschool training procedures. Unfortunately, those investigators did not analyze their data in such a way as to permit an assessment of the procedure. Nevertheless, all investigators in a sense appear to have programmed their material. Training materials were usually ordered in difficulty, and most investigators presented their materials in relatively small steps.

The studies were very useful in another way, namely in calling attention to the great caution needed in carrying out research of this kind and in interpreting results. Non-instructed control groups are difficult to set up and maintain, but they are essential for the unequivocal interpretation of experimentally produced effects. Similarly, in a pre- and post- test experimental design, children attending kindergarten must not be tested for at least a month or six weeks after entering. If this is not done, post-test gains may be contaminated by the effects of increased rapport with the examiners, by emotional adaptation, and the like. Great care must be used in keeping examiners, raters, and in certain instances teachers and parents, uninformed as to the purpose and perhaps even the existence of certain experimental procedures. Finally, examiners should not know which children are trained and which are not. Only in this way can examiner and teacher bias be kept from influencing the data.

PROCEDURE

General Plan

In northern Orange County there are four school districts each of which contains one school. At the beginning of the project in September, 1962, two of the schools had all-white enrollments, and two had all Negro. It was our plan at that time to establish kindergartens at two schools, one all-white and one all-Negro. Further, it was our plan to test all of the preschool children who were approximately five years old in these two school districts and then to establish in each of the two districts three groups of children matched on the basis of Stanford-Binet I.Q., chronological age, and sex. The members of one group in each district were not to be enrolled in the newly established kindergartens; the members of the other groups, however, were to be enrolled. In addition, the members of one of the two groups enrolled in each kindergarten were to receive special programmed instruction, while the members of the other were to participate in operant conditioning experiments. This latter procedure was planned so that the examiners and teachers would not know which children received programmed instruction and which did not, so that all children would have approximately the same amount of contact with the experimenters, and so that all children would receive essentially the same number of trinkets, charms, and pennies which were used as reinforcers.

In general the plan proved to be feasible except for one difficulty. This was that almost all parents insisted on their children being allowed to attend the kindergartens. As a consequence the non-kindergarten control groups in both kindergarten districts had to be eliminated. This left two groups of children in each of the kindergarten districts, i.e. a group attending kindergarten and receiving usual kindergarten instruction and one which would received special programmed instruction in addition to the kindergarten experience. In order to replace the control children in the two kindergarten districts, we decided to use the preschool children in the other two school districts, where kindergartens had not been established. Therefore, all five-year-old children in these districts reported to us by the school board were tested and put in the non-kindergarten control groups. Comparisons of data indicate that in spite of the fact that these children were not selected, their match with the corresponding experimental groups was surprisingly close in respect to chronological age and Stanford-Binet I.Q. The six experimental groups and the training they received may be summarized as follows:

White Children

A. Kindergarten experience plus special programmed instruction
B. Kindergarten experience only
C. Neither kindergarten experience nor programmed instruction

Negro Children

D. Kindergarten experience plus special programmed instruction
E. Kindergarten experience only
F. Neither kindergarten experience nor programmed instruction

One problem which arose and which will be discussed in detail later is that the teachers and the teaching methods of the schools which the non-kindergarten children attended in subsequent years apparently differed from those of the two schools where we had established the kindergartens. This made later comparisons of test scores and interpretations of performance differences more difficult.

Testing Procedure

Children entering the kindergartens were tested with the Stanford-Binet and Primary Mental Abilities tests during the fall when they entered, or more precisely, they were tested from four to six weeks after they entered. They were tested again in the spring at the end of that preschool year. During the first three years of the project, children of the same age who lived in the school districts where no kindergartens had been established were tested by the same examiners during the same periods. During the fourth year, no preschool children who lived in those two school districts which did not have kindergartens were tested. Those children living in the kindergarten districts and attending the kindergartens, however, were tested as usual. All children who entered the experiment before 1965 were later tested at the end of their first year in school. They were also tested at the end of their second year in school if they had entered the experiment in 1962 and 1963. The later follow-up testing entailed the use of not only the Stanford-Binet and P.M.A. tests but the Stanford Achievement test as well. The testing programs may be summarized as follows:

	Testing Dates							
Children who entered kindergartens in	Fall 1962	Spring 1963	Fall 1963	Spring 1964	Fall 1964	Spring 1965	Fall 1965	Spring 1966
Fall 1962	K	K		1st G		2nd G		
Fall 1963			K	K		1st G		2nd G
Fall 1964					K	K		1st G
Fall 1965							K	K
Non-kindergarten children who entered experiment in								
Fall 1962	Pre-S	Pre-S		1st G		2nd G		
Fall 1963			Pre-S	Pre-S		1st G		2nd G
Fall 1964					Pre-S	Pre-S		1st G
Fall 1965							--	--

All of the examiners were highly skilled and were very successful in evoking responses from shy, rural children. The Negro children were tested by Negro examiners, and the white children, by white examiners.

The chronological ages, in years and months, of the children when they entered the experiment were as follows:

	Mean	Range
White Kindergarten	5 - 5.3	4--11 to 5--11
Negro Kindergarten	5 - 5.9	4--11 to 6--7
White non-Kindergarten	5 - 6.2	5--0 to 6--1
Negro non-Kindergarten	5 - 6.2	5--0 to 6--1

Note that a few children were older than the legal school age when they first entered the kindergartens or when they were initially tested as non-kindergarten preschool children.

In regard to the testing procedures it should be noted that the examiners (and the teachers as well) knew which children attended kindergarten and which did not. This was due to the fact that kindergarten children and non-kindergarten children lived in different school districts and attended different schools. Caution, therefore, is dictated in assessing the effects of kindergarten experience. On the other hand, none knew which child had received special programmed instruction and which had not.

Attention must also be called to two other problems encountered in carrying out the testing. First, nine children were found to be untestable at the time of their first preschool testing. If such children were enrolled in the kindergarten, they were allowed to continue. Most became testable at a later time, but none of their data were included in subsequent comparisons and analyses. Second, 50 of the 371 children who had been tested during their respective preschool or kindergarten years were not tested at later scheduled times in the first and second grades because they had moved away. Twenty-six of these had attended the kindergartens; twenty-four had not. Our solution to this problem was the same as above, i.e. not to use any of their data in our analyses. Thus, no data of a child were used in our analyses unless he was present for all of his scheduled tests.

Operation of the Kindergartens

The kindergartens were operated jointly by the U. S. Office of Education project and the Orange County School system. The salaries of teachers and teaching assistants were consistent with local pay scales. Their cost and the cost of major pieces of equipment were paid for by the project and by the University of North Carolina. The Orange County school system supplied the project with class rooms and school supplies. It also furnished transportation *via* school buses and made available lunch room facilities.

The kindergarten children, although younger than their counterparts enrolled in school, followed essentially the same schedule. They were picked up in the morning by the same buses which transported the school children and arrived for class at the same time, 8:30 a.m. Similarly, they left the kindergartens at 3:30 p.m. and were taken home by school bus. Again, precisely the same schedule was followed by the regularly enrolled school children. Because this seemed like an especially long day for such young children, most of their academic and special training activities were carried on in the morning with much of the afternoon being devoted to rest and play.

All regular instruction in each kindergarten was carried on by a teacher and a teaching assistant. During the four year period three different teachers taught at each of the kindergartens. Because so many different teachers were involved in kindergarten instruction and because each developed somewhat different programs, it is difficult to describe the kindergarten curriculum simply. An analysis of the curriculum descriptions given by each of the teachers indicates that most teachers included the following activities:

1. Training in verbal skills
    a. Teacher reading and telling stories to the class
    b. Children dramatizing stories
    c. Playing show and tell
    d. Letter recognition and printing
    e. Phonics, e.g. naming pictured objects and noting similarities in initial or final sounds
    f. Arranging sequences of pictures in order to tell a story
2. Training in quantitative skills
    a. Counting objects
    b. Telling time
    c. Using the calendar
    d. Learning the concept of temperature and how it is measured
3. Training in science
    a. How plants grow, taught through pictures and posters
    b. Names and characteristics of various animals, taught through use of similar pictures
    c. Concepts of movement

   d. Concepts of weather

4. Perceptual training
   a. Matching patterns and pictures
   b. Selecting odd or different stimulus and telling how it is different

5. Art training
   a. Using scissors, paint, crayons, and construction paper
   b. Listening to records
   c. Singing and using rhythm instruments

Once more it should be noted that this list is not exhaustive nor does it represent the activities of any one teacher. It should also be noted that in general both the kindergarten curriculum and the type of instruction were traditional, and all instruction was carried out in the context of the school.

Special Programmed Instruction

Training procedure used during first three years. Approximately one-half of the children who attended the kindergartens were given special programmed instruction. During the first three years this entailed the use of matching-to-sample programs and presenters. During the fourth year punched-tape controlled typewriters in conjunction with projectors and magnetic tape decks were used to present verbal programs. The matching-to-sample procedures required the making of discriminations of increasing difficulty. The program materials were in the form of 35 mm. Kodachrome transparencies. These had been prepared by photographing appropriate pictures, cardboard forms, mosaic patterns, letters, etc. The program slides, which were projected, were presented by means of four-window consoles. It was the task of the children to match each sample stimulus presented in the top window of a console with one of three alternative stimuli presented in the three windows below it. This was accomplished by first presenting to a child a sample stimulus in the top window of the console. The child then pressed the top window. This opened the bottom shutter, exposing the three alternative stimuli which were projected on the three lower windows. If the child pressed the incorrect lower window, i.e. a window which contained a non-matching stimulus, the bottom shutter closed, once more blocking the child's view of the three alternative stimuli in the lower windows. It was the child's task then to press the top or sample window once again, exposing once more the three alternative stimuli. If the child then pressed the correct window, a buzzer sounded, a red light was momentarily activated, both the top and bottom shutters closed, and a new slide was automatically inserted in the projector. After approximately two seconds the top shutter opened automatically, exposing a new sample stimulus. The child then went through the same procedure. Stimulus presenters and programs of this type have been described previously by Skinner (1960, 1961), Holland (1961), and Hively (1962, 1964).

During the first year the programs were constantly being revised in order to reduce the error rate. This does not mean that difficult discriminations were removed but rather that additional slides, and thus additional discriminative steps, were put in the program ahead of the ones previously found to be difficult. For various reasons some programs were completely eliminated and replaced by others. Those programs which were successfully edited and used in an unchanged form for at least two years are the following:

1. Programs designed to increase perceptual accuracy
    - a. Matching pictures of flowers, fruit, animals, and people
    - b. Matching letters
    - c. Matching pictures of flags and pennants (in color)
    - d. Matching pictures of flags and pennants (in black and white)
    - e. Matching pictures of mosaic patterns
2. Programs designed to improve verbal and perceptual skills
    - a. Matching words
    - b. Matching non-meaningful letter sequences
3. Programs designed to improve deductive and quantitative skills
    - a. Matching pictures of groups of objects solely on the basis of number in the presence of sometimes competing arrangements or configurations
    - b. Matching on the basis of equivalent relations, e.g. one large blue square equals five small yellow squares, etc.
4. Programs designed to improve spatial visualization
    - a. Matching pictures of jigsaw puzzle pieces, often when sample or matching stimulus had been rotated
    - b. Matching by indicating which alternative would complete a figure
5. Programs designed to improve inductive skills: matching by indicating which symbol or figure comes next in a sequence

Although the discriminative stimuli were all visual, the child was urged to supply and to use other stimuli and was assisted in this regard by the experimenter in a number of ways. The experimenter, for example, encouraged the child to tact the stimuli, i.e. to describe them verbally or name them out loud. Usually, the experimenter himself had to do this several times before the child began to do it. The experimenter also prompted the child from time to time if he ceased to verbalize the stimuli. This procedure was followed in an attempt both to make the visual stimuli more discriminable and to add verbal mediation, additionally promoting the development of verbal behavior.

The experimenter interacted with the children in yet another way, namely, as a mediator of reinforcement. He showed the children the trinkets, charms, and pennies which they would earn by successfully completing a certain number of correct discriminations; and it was he who in fact later presented the reinforcers to each child. In addition, he supplied social reinforcement from time to time by saying "good" or some other socially approving work or expression when a child made a correct response. He also supplied aversive social stimuli, i.e. a disapproving word or expression, when a child made a mistake. The social interaction between the experimenter and the children was found to be helpful in reinforcing almost all of the children, but it was especially useful in the case of the Negro children, who often would not match unless the experimenter was present in the experimental rooms and intermittently supplying social reinforcement.

Training procedure used during the fourth year. During the fourth year the amount of time and effort devoted to matching-to-sample was greatly reduced, only the four or five simplest perceptual programs being used. Instead, training was carried out with new programs and another type of auto-instructional device, one composed of a punched-tape controlled typewriter, a photoelectrically-cued magnetic tape deck, a 35 mm. projector, and associated circuitry. The technique resembled in some regards that described by O. K. Moore (1963). The programs were designed to give verbal training, e.g. echoing, texting, tacting, and intraverbalizing. The content areas covered by the seven programs used were the following:

1. People, e.g. man, woman, boy, girl, child, husband, wife, mother, father
2. Food, e.g. bread, butter, milk, banana, steak, hamburger, carrots, potatoes, strawberries, pie, ice cream
3. Parts of the body, e.g. hair, nose, lips, teeth, eyebrow, arm, hand, leg
4. Animals, e.g. horse, cow, dog, cat, lion, tiger, monkey, elephant, rhinoceros
5. Professions, e.g. policemen, fireman, actor, judge, soldier, cook, teacher, farmer
6. Actions, e.g. sitting, running, swimming, standing, washing, combing, sewing, cooking, reading
7. Clothes, e. g. dress, pants, skirt, shirt, coat, raincoat, hat, scarf

The list of examples presented here with each program is by no means complete, only illustrative. Actually, each program contained 40 to 60 different words.

The programs were composed of three components. These were slides (35 mm. transparencies), verbal descriptions, definitions, and discussions recorded on magnetic tape, and punched tape sequences which were read into a memory and verifier circuit to determine whether or not the child made a correct or incorrrect typing response. Each program contained approximately 300 different slides and verbal descriptions. During a given program several slides and verbal descriptions were devoted to each word. These were always presented consecutively. The number of instances of each word varied from four to eight, depending on the length and meaningfulness of the word.

The following procedure was used during this phase of training. A child sat at a typewriter where he saw a picture projected on a translucent screen. He heard a 30-second discussion read by the tape deck which described the important parts of the picture. As soon as the discussion had been completed, the taped voice said, "Spell DOG" (or the name of whatever object was being projected and discussed). The taped voice then slowly said D__O__G__ with sufficient time between each letter for the child to echo what the voice had said. For many children, this slow rate of spelling was necessary only for the first time or two that a word was presented. After that, the child came to anticipate the spelling and did so before the taped voice finished spelling the word. The voice then said, "Say DOG", and the child did so. Shortly thereafter, the voice instructed the child to type DOG. The child then did this, and on the completion of the last letter, a buzzer sounded, a bright red light was projected on the screen for three seconds, the slide changed, and the tape deck was started so that it began to read a new message. If the child made an error, the typewriter was automatically reset, and the child had to start that item over again. Thus, if the child typed DOX, the typewriter was reset, and the state of the verifier was changed so that D was the letter which had to be typed next in order to be correct. The child might then type DOG and advance the slide, start the tape deck, etc., or he might make an error and have to repeat the sequence. Usually, few errors were made so that the letter sequences did not have to be repeated very often.

Our training sequences qualified as programs only in the sense that they presented the child with an orderly sequence of thematically related slides and recorded messages. No explicit fading of prompts or supplementary stimuli, however, was carried out. Thus, when the child spelled a word vocally, he was assisted by the echoic stimuli of the tape. Similarly, when he typed a word, he saw the letters projected on the screen together with an appropriate picture. An interesting thing, however, took place, i.e. many children effected their own fading. Thus, in the case of vocally spelling a given word, children often anticipated the spelling stimuli supplied by the tape deck after one or two presentations of a given word. Similarly, after they "copied" a word one or two times, they no longer looked at the screen when they were asked by the taped voice to type that same word a third or fourth time.

The reinforcing procedure used during the fourth year also differed somewhat from that of the preceding years. As before, whenever a child made a correct response, i.e. typed a word correctly, a buzzer sounded, the screen was illuminated with a red light, and a new slide was projected, but because in this procedure auditory stimuli were used, a new taped message was also read. A more important difference in the training sequences, however, lay in the introduction of a token-exchange reinforcement procedure. This entailed reinforcing a child with a metal token for each word typed correctly. At the end of a session, the tokens could be exchanged for various kinds of toys and candy, or they could be inserted in an exchange device which gave the child a penny and a charm for every three tokens. The pennies could then be inserted in vending machines which contained a large variety of trinkets. They could also be used to buy toys and candy, or they could be kept if the child so desired. The increased diversity of reinforcers was felt to be necessary because of the longer experimental sessions and their greater frequency. Similar token-exchange procedures have been reported by a number of investigators, e.g. Staats _et_ _al_. (1962, 1964) and Birnbrauer _et_ _al_.(1964, 1965).

RESULTS

Analysis of Results with Training Procedures Used in 1962, 1963, and 1964

Analysis of Stanford-Binet I.Q.'s. In Table 1 are presented the mean Stanford-Binet I.Q.'s obtained from those children who entered the experiment in 1962, in 1963, and in 1964. Scores were obtained from those who entered in 1962 and 1963 at four different times. These were: (1) in the fall of their kindergarten year (or their last preschool year, if the children did not attend a kindergarten), (2) during the spring of that same academic year, (3) during the spring of the following year, i.e. at the end of their first year in school, and (4) at the end of their second year in school. Only the first three scores are available for those who entered the experiment in 1964. Also included in Table 1 are the numbers of children in each subgroup and the grand means for all experimental conditions.

Table 2 contains the mean differences between the scores obtained during the fall of the kindergarten or the last preschool year and the scores obtained during the spring of that same year. Table 2 thus reflects any change occurring during the last preschool year as it relates to kindergarten experience and to kindergarten experience plus special programmed instruction. Table 3 contains the mean differences between the scores obtained during the fall of the kindergarten or last preschool year and those obtained during the spring of the first year in school. This table thus depicts any change which took place over two years instead of the one kindergarten or preschool year and indicates

TABLE 1

Means of Stanford-Binet I.Q.'s

White Children Who Began In	Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall - Last Preschool Year	Spring - Last Preschool Year	First Grade	Second Grade
1962	94.54	103.46	109.38	104.08	96.40	103.10	111.30	112.80	102.80	107.30	114.15	113.00
(N)	(13)	(13)	(13)	(13)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1963	108.09	115.45	117.27	116.00	102.79	114.93	112.79	111.96	101.30	103.20	107.65	110.40
(N)	(11)	(11)	(11)	(11)	(14)	(14)	(14)	(14)	(20)	(20)	(20)	(20)
1964	96.50	99.92	106.33	———	94.67	103.00	104.33	———	98.46	98.83	104.00	———
(N)	(12)	(12)	(12)		(12)	(12)	(12)		(24)	(24)	(24)	
Total	3576.01	3813.97	3987.87	2629.04	3539.10	3876.02	3944.02	2694.04	6445.04	6581.92	6932.00	4468.00
(N)	(36)	(36)	(36)	(24)	(36)	(36)	(36)	(24)	(64)	(64)	(64)	(40)
$\bar{X}$	99.33	105.94	110.77	109.54	98.31	107.67	109.56	112.25	100.70	102.84	108.31	111.70
Negro Children Who Began In												
1962	93.00	95.89	93.78	90.33	91.15	90.46	93.54	89.38	92.40	92.35	90.20	92.75
(N)	(9)	(9)	(9)	(9)	(13)	(13)	(13)	(13)	(20)	(20)	(20)	(20)
1963	96.82	96.45	95.73	92.55	97.20	98.10	88.80	88.40	91.15	88.75	86.65	89.15
(N)	(11)	(11)	(11)	(11)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1964	89.36	93.14	91.43	———	89.29	89.79	90.64	———	84.75	86.75	89.04	———
(N)	(14)	(14)	(14)		(14)	(14)	(14)		(24)	(24)	(24)	
Total	3153.06	3227.92	3177.07	1831.02	3407.01	3414.04	3372.98	2045.94	5705.00	5704.00	5673.96	3638.00
(N)	(34)	(34)	(34)	(20)	(37)	(37)	(37)	(23)	(64)	(64)	(64)	(40)
$\bar{X}$	92.74	94.94	93.44	91.55	92.08	92.27	91.16	88.95	89.14	89.13	88.66	90.95

TABLE 2

Mean Changes in Stanford-Binet I.Q.'s during the Kindergarten or Preschool Year

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	7.95	4.50	2.07	< .25	8.92	6.70	< 1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	10.04	1.90	31.58*	< .01	7.36	12.14	6.04*	< .05
(N)	(25)	(20)			(11)	(14)		
1964	5.87	0.37	6.98*	< .05	3.42	8.33	2.79	< .25
(N)	(24)	(24)			(12)	(12)		
All Years	7.98	2.14	16.20*	< .01	6.61	9.36	1.91	< .25
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	0.77	-0.05	< 1.00	—	2.89	-0.69	1.64	< .25
(N)	(22)	(20)			(9)	(13)		
1963	0.24	-2.40	1.10	> .25	-0.37	0.90	< 1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	2.14	2.00	< 1.00	—	3.78	0.50	1.45	< .25
(N)	(28)	(24)			(14)	(14)		
All Years	1.15	-0.01	< 1.00	—	2.20	0.19	1.36	< .25
(N)	(71)	(64)			(34)	(37)		

TABLE 3

Mean Changes in Stanford-Binet I.Q.'s during the Kindergarten or Preschool Year Plus the First Year in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	14.86	11.35	1.17	$> .25$	14.84	14.90	< 1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	9.64	6.35	1.62	$< .25$	9.18	10.00	< 1.00	—
(N)	(25)	(20)			(11)	(14)		
1964	9.74	5.54	3.48	$< .10$	9.83	9.66	< 1.00	—
(N)	(24)	(24)			(12)	(12)		
All Years	11.34	7.61	5.60^*	$< .05$	11.44	11.25	< 1.00	—
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	1.72	-2.20	3.04	$< .10$	0.78	2.39	< 1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	-4.57	-4.50	< 1.00	—	-1.09	-8.40	4.66^*	$< .05$
(N)	(21)	(20)			(11)	(10)		
1964	1.71	4.29	1.53	$< .25$	2.07	1.35	< 1.00	—
(N)	(28)	(24)			(14)	(14)		
All Years	-0.15	-0.48	1.00	—	0.70	-0.92	< 1.00	—
(N)	(71)	(64)			(34)	(37)		

its dependency on kindergarten experience and on kindergarten experience plus special programmed instruction, Similarly, Table 4 contains the mean changes taking place over three years, i.e. the kindergarten year, the first year in school, and the second year in school. Tables 2, 3, and 4 also include F - and p - values for appropriate comparisons.

The data of these tables yield the following information.

(1) White children who attended kindergarten during their last preschool year showed consistently greater increases in Stanford-Binet I.Q. during that year than did white children who did not attend kindergarten. The difference was not significant at the 5 per cent level or better for the 1962-63 group, but was significant for those children who attended kindergarten during 1963-64 and during 1964-65. The difference between the combined scores of all three waves is also significant. (The term waves is borrowed from Weikart and is necessary because the term years would otherwise be used in at least two different ways. In the present case the term wave refers to a group entering the experiment during a particular year. Thus, Wave I might refer to those children who entered the experiment in 1962. In the same way, Waves II and III would refer to those entering in 1963 and in 1964 respectively. The expression combined over all waves means that the appropriate difference scores of all three entering groups have been combined.) These gains resemble those reported by Wellman (1943).

(2) For the white children there are no consistent effects resulting from the special programmed instruction during the preschool year.

TABLE 4

Mean Changes in Stanford-Binet I.Q.'s during the Kindergarten or Preschool Year

Plus the First and Second Years in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	12.52	10.20	< 1.00	—	9.54	16.40	2.67	<.25
(N)	(23)	(20)			(13)	(10)		
1963	8.56	9.10	< 1.00	—	7.91	9.07	< 1.00	—
(N)	(25)	(20)			(11)	(14)		
1964	—	—			—	—		
(N)								
All Years	10.45	9.65	< 1.00	—	8.79	12.12	1.60	<.25
(N)	(48)	(40)			(24)	(24)		
Negro Children Who Began In								
1962	-2.14	0.35	< 1.00	—	-2.67	-1.77	< 1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	-6.43	-2.00	3.02	<.10	-4.27	-8.80	1.62	<.25
(N)	(21)	(20)			(11)	(10)		
1964	—	—			—	—		
(N)								
All Years	-4.24	-0.83	2.80	<.10	-3.55	-4.83	< 1.00	—
(N)	(43)	(40)			(20)	(23)		

(3) Neither kindergarten experience nor the special programmed instruction differentially influenced the Stanford-Binet I.Q.'s of the Negro children during the preschool year.

(4) Comparisons of white children at the end of the first grade show that those who had attended kindergartens consistently gained more over the preschool year plus the first year in school than did those who had not attended kindergartens during their last preschool year. This effect, though consistent, is not statistically significant for any one wave. The effect is significant, however, when the data for all waves (Those entering in 1962, in 1963, and in 1964) are combined. Again the special programmed instruction had no significant effect.

(5) Changes demonstrated by the Negro children over the same two years were not influenced in any consistent way by either kindergarten experience or the special programmed instruction. The Negro children in the 1963 wave showed a significant programmed instruction effect, but this is viewed as a chance effect in much the same way as was the significant reversed effect found for the program-instructed white children during the preschool year of the 1963 wave.

(6) Mean changes in Stanford-Binet I.Q. taking place over the preschool year plus the first and second years in school were not influenced by either kindergarten experience or kindergarten experience plus special programmed instruction. This was true for both Negro and white children.

Analysis of P.M.A. Total Quotient Scores. Table 5 contains the mean P.M.A. total quotient scores obtained from the same groups whose Stanford-Binet I.Q.'s were presented in Table 1. As in the case of the Stanford-Binet data, four quotient scores were obtained from those children who entered the experiment in 1962 and in 1963, while only the first three were available for those who entered in 1964. Tables 6, 7, and 8 contain the mean differences between the scores which were obtained at the successive test administrations. These data are arranged in the same way as the Stanford-Binet I.Q. differences which were presented in Tables 2, 3, and 4. The data presented in these tables yield the following information:

(1) White children who attended kindergarten during their last preschool year consistently showed greater gains during that year than did those children who did not attend. The differences, however, are not statistically significant. No consistent changes of any kind were found to occur over the preschool year plus the first year in school and over the preschool year plus the first and second years in school.

(2) No consistent programmed instruction effects were found in the case of the white children. This was true for the kindergarten year, the kindergarten year plus the first year in school, and the kindergarten year plus the first and second years in school.

(3) The P.M.A. total quotients of the Negro children were influenced to a greater degree by kindergarten experience than were those of the white children. Negro children who attended the kindergarten during their last preschool year, for example, showed significantly

TABLE 5

Means of P.M.A. Total Quotients

White Children Who Began In	Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall - Last Preschool Year	Spring - Last Preschool Year	First Grade	Second Grade
1962	72.61	85.62	95.08	93.54	73.00	92.20	102.60	100.00	75.80	89.95	99.75	102.90
(N)	(13)	(13)	(13)	(13)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1963	80.73	95.64	104.00	105.55	83.50	92.57	101.64	100.57	78.10	86.85	98.45	98.85
(N)	(11)	(11)	(11)	(11)	(14)	(14)	(14)	(14)	(20)	(20)	(20)	(20)
1964	75.83	86.50	100.75	———	75.42	85.58	100.50	———	79.83	86.79	99.08	———
(N)	(12)	(12)	(12)		(12)	(12)	(12)		(24)	(24)	(24)	
Total	2741.92	3203.10	3589.04	2377.07	2804.04	3244.94	3654.96	2407.98	4993.92	5618.96	6341.92	4035.00
(N)	(36)	(36)	(36)	(24)	(36)	(36)	(36)	(24)	(64)	(64)	(64)	(40)
$\bar{X}$	76.16	88.98	99.70	99.04	77.89	90.14	101.53	100.33	78.03	87.80	99.09	100.88
Negro Children Who Began In												
1962	52.44	72.89	88.78	82.11	58.23	70.92	83.85	76.08	54.45	62.80	83.40	83.20
(N)	(9)	(9)	(9)	(9)	(13)	(13)	(13)	(13)	(20)	(20)	(20)	(20)
1963	59.36	76.54	91.90	80.73	61.10	76.80	89.40	74.40	58.75	61.55	81.15	78.65
(N)	(11)	(11)	(11)	(11)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1964	54.57	75.14	86.14	———	57.86	73.21	84.07	———	54.92	59.83	79.79	———
(N)	(14)	(14)	(14)		(14)	(14)	(14)		(24)	(24)	(24)	
Total	1888.90	2549.91	3015.88	1627.02	2178.03	2714.90	3161.03	1733.04	3582.08	3922.92	5205.96	3237.00
(N)	(34)	(34)	(34)	(20)	(37)	(37)	(37)	(23)	(64)	(64)	(64)	(40)
$\bar{X}$	55.56	75.00	88.70	81.35	58.87	73.38	85.43	75.35	55.97	61.30	81.34	80.93

TABLE 6

Mean Changes in P.M.A. Total Quotients during the Kindergarten or Preschool Year

White Children Who Began In	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
1962	15.70	14.15	< 1.00	—	13.01	19.20	1.73	$< .25$
(N)	(23)	(20)			(13)	(10)		
1963	11.64	8.75	1.22	$> .25$	14.91	9.07	2.75	$< .25$
(N)	(25)	(20)			(11)	(14)		
1964	10.41	6.96	2.58	$< .25$	10.67	10.16	< 1.00	—
(N)	(24)	(24)			(12)	(12)		
All Years	12.53	9.77	2.90	$< .10$	12.82	12.25	< 1.00	—
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	15.87	8.35	4.42^*	$< .05$	20.45	12.69	2.39	$< .25$
(N)	(22)	(20)			(9)	(13)		
1963	16.47	2.80	20.45^*	$< .01$	17.18	15.70	< 1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	17.96	4.92	24.22^*	$< .01$	20.57	15.35	2.10	$< .25$
(N)	(28)	(24)			(14)	(14)		
All Years	16.87	5.33	43.25^*	$< .01$	19.44	14.51	4.15^*	$< .05$
(N)	(71)	(64)			(34)	(37)		

TABLE 7

Mean Changes in P.M.A. Total Quotients during the Kindergarten or Preschool Year Plus the First Year in School

White Children Who Began In	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
1962	25.57	23.95	< 1.00	—	22.47	29.60	2.26	< .25
(N)	(23)	(20)			(13)	(10)		
1963	20.40	20.35	< 1.00	—	23.27	18.14	1.63	< .25
(N)	(25)	(20)			(11)	(14)		
1964	25.00	19.25	2.22	< .25	24.92	25.08	< 1.00	—
(N)	(24)	(24)			(12)	(12)		
All Years	23.58	21.06	1.56	< .25	23.54	23.64	< 1.00	—
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	30.01	28.95	< 1.00	—	36.34	25.62	11.00*	< .01
(N)	(22)	(20)			(9)	(13)		
1963	30.52	22.40	6.01*	< .05	32.54	28.30	< 1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	28.89	24.87	2.16	< .25	31.57	26.21	2.08	< .25
(N)	(28)	(24)			(14)	(14)		
All Years	29.72	25.37	7.14*	< .01	33.14	26.56	8.62*	< .01
(N)	(71)	(64)			(34)	(37)		

TABLE 8

Mean Changes in P.M.A. Total Quotients during the Kindergarten or Preschool Year Plus the First and Second Years in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	23.57	27.10	<1.00	—	20.93	27.00	1.51	$<.25$
(N)	(23)	(20)			(13)	(10)		
1963	20.48	20.75	<1.00	—	24.82	17.07	3.30	$<.10$
(N)	(25)	(20)			(11)	(14)		
1964	—	—			—	—		
(N)								
All Years	21.96	23.93	<1.00	—	22.71	21.20	<1.00	—
(N)	(48)	(40)			(24)	(24)		
Negro Children Who Began In								
1962	22.69	28.75	2.70	$<.25$	29.67	17.85	5.20^*	$<.05$
(N)	(22)	(20)			(9)	(13)		
1963	17.53	19.90	<1.00	—	21.37	13.30	2.37	$<.25$
(N)	(21)	(20)			(11)	(10)		
1964	—	—			—	—		
(N)								
All Years	20.17	24.33	2.34	$<.25$	25.10	15.87	5.93^*	$<.05$
(N)	(43)	(40)			(20)	(23)		

greater gains during that year than did Negro children who did not attend. The differences were significant during the years of 1962-63, 1963-64, and 1964-65, and for all of those waves combined. Consistent kindergarten effects were also produced over the preschool year plus the first year in school. The effect for all waves combined is statistically significant. Reversed effects were found over the preschool year plus the first and second years in school, but the differences are not statistically significant.

(4) Negro children who received special programmed instruction consistently gained more during the kindergarten year than did those who did not receive the instruction. The difference between the combined scores for all three waves is statistically significant. Similar effects were found over the preschool year plus the first year in school and over the preschool year plus the first and second years in school. When scores were combined over all waves, both differences proved to be statistically significant.

Analysis of Verbal Quotient Scores. Table 9 contains the mean quotients made by the various groups on the Verbal Meaning subtest of the P.M.A. Tables 10, 11, and 12 contain the mean differences between the scores obtained at the successive testing sessions. These data yield the following information:

(1) In the case of the white children, neither the kindergarten nor the programmed instruction had any consistent effect on the gains over the preschool year and over the preschool year plus the first year in school. A comparison of the combined gains over the preschool

TABLE 9

Means of P.M.A. Verbal Quotients

White Children Who Began In	Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall - Last Preschool Year	Spring - Last Preschool Year	First Grade	Second Grade
1962	80.31	86.15	87.62	85.85	83.20	87.40	93.80	93.30	86.45	91.55	93.90	102.05
(N)	(13)	(13)	(13)	(13)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1963	88.00	92.18	99.08	102.73	95.00	93.07	97.29	97.50	85.65	87.20	94.25	95.35
(N)	(11)	(11)	(11)	(11)	(14)	(14)	(14)	(14)	(20)	(20)	(20)	(20)
1964	86.67	89.42	99.58	—	86.58	91.92	95.08	—	83.08	86.88	92.83	—
(N)	(12)	(12)	(12)		(12)	(12)	(12)		(24)	(24)	(24)	
Total	3052.07	3206.97	3423.90	2246.08	3200.96	3280.02	3441.02	2298.00	5435.92	5660.12	5990.92	3948.00
(N)	(36)	(36)	(36)	(24)	(36)	(36)	(36)	(24)	(64)	(64)	(64)	(40)
$\bar{X}$	84.78	89.08	95.11	93.59	88.92	91.11	95.58	95.75	84.94	88.44	93.61	98.70
Negro Children Who Began In												
1962	72.89	77.67	82.78	83.56	76.15	78.08	79.62	82.62	73.45	73.55	75.10	82.25
(N)	(9)	(9)	(9)	(9)	(13)	(13)	(13)	(13)	(20)	(20)	(20)	(20)
1963	78.73	78.36	87.27	83.36	76.30	79.40	83.00	80.20	74.20	72.15	75.75	79.05
(N)	(11)	(11)	(11)	(11)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1964	77.93	82.71	87.50	—	74.79	76.93	78.21	—	75.33	74.29	79.00	—
(N)	(14)	(14)	(14)		(14)	(14)	(14)		(24)	(24)	(24)	
Total	2613.06	2718.93	2929.99	1669.00	2800.01	2886.06	2960.00	1876.06	4760.92	4696.96	4913.00	3226.00
(N)	(34)	(34)	(34)	(20)	(37)	(37)	(37)	(23)	(64)	(64)	(64)	(40)
$\bar{X}$	76.85	79.97	86.18	83.45	75.68	78.00	80.00	81.57	74.39	73.39	76.77	80.65

TABLE 10

Mean Changes in P.M.A. Verbal Quotients during the Kindergarten or Preschool Year

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	5.12	5.10	< 1.00	—	5.84	4.20	< 1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	0.76	1.55	< 1.00	—	4.18	-1.93	1.94	< .25
(N)	(25)	(20)			(11)	(14)		
1964	4.04	3.80	< 1.00	—	2.75	5.34	< 1.00	—
(N)	(24)	(24)			(12)	(12)		
All Years	3.25	3.50	< 1.00	—	4.30	2.19	< 1.00	—
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	3.10	0.10	1.88	< .25	4.78	1.93	< 1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	1.29	-2.05	3.10	< .10	-0.37	3.10	1.70	< .25
(N)	(21)	(20)			(11)	(10)		
1964	3.46	-1.04	3.95	< .10	4.78	2.14	< 1.00	—
(N)	(28)	(24)			(14)	(14)		
All Years	2.70	-1.00	8.89*	< .01	3.12	2.32	< 1.00	—
(N)	(71)	(64)			(34)	(37)		

TABLE 11

Mean Changes in P.M.A. Verbal Quotients during the Kindergarten or Preschool Year Plus the First Year in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	8.74	7.45	< 1.00	—	7.31	10.60	< 1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	6.16	8.60	< 1.00	—	11.08	2.29	3.33	< .10
(N)	(25)	(20)			(11)	(14)		
1964	10.70	9.75	< 1.00	—	12.91	8.50	< 1.00	—
(N)	(24)	(24)			(12)	(12)		
All Years	8.52	8.67	< 1.00	—	10.33	6.66	1.83	< .25
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	6.09	1.65	3.85	< .10	9.89	3.47	4.10	< .10
(N)	(22)	(20)			(9)	(13)		
1963	7.67	1.55	5.47^*	< .05	8.54	6.70	< 1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	6.50	3.67	1.23	< .25	9.57	3.42	3.13	< .10
(N)	(28)	(24)			(14)	(14)		
All Years	6.72	2.38	9.27^*	< .01	9.33	4.32	6.46^*	< .05
(N)	(71)	(64)			(34)	(37)		

TABLE 12

Mean Changes in P.M.A. Verbal Quotients during the Kindergarten or Preschool Year Plus the First and Second Years in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	7.52	15.60	7.22^{*}	< .05	5.54	10.10	1.22	> .25
(N)	(23)	(20)			(13)	(10)		
1963	7.88	9.70	< 1.00	—	14.73	2.50	8.33^{*}	< .01
(N)	(25)	(20)			(11)	(14)		
1964	—	—			—	—		
(N)								
All Years	7.71	12.65	4.67^{*}	< .05	9.76	5.67	1.75	< .25
(N)	(48)	(40)			(24)	(24)		
Negro Children Who Began In								
1962	8.18	8.80	< 1.00	—	10.67	6.47	< 1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	4.29	4.85	< 1.00	—	4.63	3.90	< 1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	—	—			—	—		
(N)								
All Years	6.28	6.82	< 1.00	—	7.35	5.35	< 1.00	—
(N)	(43)	(40)			(20)	(23)		

year plus the first and second year in school, however, indicates a reversed effect, i.e. those who did not attend kindergarten gained significantly more than those who did.

(2) Those Negro children who attended kindergartens showed consistently greater gains over the preschool year and over the preschool year plus the first year in school than did those who did not attend. In both instances the differences between the combined scores are statistically significant. No consistent kindergarten effects were found over the preschool year plus the first and second years in school.

(3) Programmed instruction in the case of the Negro children produced no consistent changes during the kindergarten year. Consistent changes were produced, however, over the kindergarten year plus the first year in school, and the difference between the combined scores over all waves is statistically significant. Consistent differences were found over the kindergarten year plus the first and second years in school. None, however, are statistically significant.

Analysis of Perceptual Quotient Scores. Table 13 contains the mean quotients made by the various groups on the Perceptual speed subtest of the P.M.A. Tables 14, 15, and 16 contain the mean differences between scores obtained on successive test administrations. These data yield the following information:

(1) White children who attended kindergarten during their last preschool year consistently gained less than those who did not. This

TABLE 13

Means of P.M.A. Perceptual Speed Quotients

	Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
White Children Who Began In	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall - Last Preschool Year	Spring - Last Preschool Year	First Grade	Second Grade
1962	90.62	94.08	96.77	99.77	93.50	99.90	109.40	105.70	88.90	95.65	103.70	102.30
(N)	(13)	(13)	(13)	(13)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1963	93.09	99.45	105.27	103.18	91.50	95.07	103.71	97.43	90.45	96.55	106.80	100.65
(N)	(11)	(11)	(11)	(11)	(14)	(14)	(14)	(14)	(20)	(20)	(20)	(20)
1964	93.58	100.17	104.92	———	93.67	96.00	104.50	———	94.13	98.83	110.33	———
(N)	(12)	(12)	(12)		(12)	(12)	(12)		(24)	(24)	(24)	
Total	3325.01	3519.03	3675.02	2431.99	3340.04	3481.98	3799.94	2421.02	5846.12	6215.92	6897.92	4059.00
(N)	(36)	(36)	(36)	(24)	(36)	(36)	(36)	(24)	(64)	(64)	(64)	(40)
$\bar{X}$	92.36	97.75	102.08	101.33	92.78	96.72	105.55	100.88	91.35	97.12	107.78	101.48
Negro Children Who Began In												
1962	73.00	87.33	99.00	91.56	76.31	87.54	94.46	90.92	78.15	85.00	94.25	96.50
(N)	(9)	(9)	(9)	(9)	(13)	(13)	(13)	(13)	(20)	(20)	(20)	(20)
1963	85.45	95.45	97.45	91.09	83.20	93.70	94.50	84.40	80.95	83.50	93.45	91.80
(N)	(11)	(11)	(11)	(11)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1964	75.57	92.64	95.07	———	83.00	92.57	99.86	———	78.00	82.17	85.79	———
(N)	(14)	(14)	(14)		(14)	(14)	(14)		(24)	(24)	(24)	
Total	2654.93	3132.88	3293.93	1826.03	2986.03	3371.00	3571.02	2025.96	5054.00	5342.08	5812.96	3766.00
(N)	(34)	(34)	(34)	(20)	(37)	(37)	(37)	(23)	(64)	(64)	(64)	(40)
$\bar{X}$	78.09	92.14	96.88	91.30	80.70	91.11	96.51	88.09	78.97	83.47	90.83	94.15

TABLE 14

Mean Changes in P.M.A. Perceptual Speed Quotients during the Kindergarten or Preschool Year

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	4.74	6.75	< 1.00	—	3.46	6.40	< 1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	4.80	6.10	< 1.00	—	6.36	3.57	< 1.00	—
(N)	(25)	(20)			(11)	(14)		
1964	4.46	4.70	< 1.00	—	6.59	2.33	1.81	< .25
(N)	(24)	(24)			(12)	(12)		
All Years	4.67	5.77	< 1.00	—	5.39	3.94	< 1.00	—
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	12.49	6.85	1.55	< .25	14.33	11.23	< 1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	10.24	2.55	8.06*	< .01	10.00	10.50	< 1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	13.32	4.17	13.37*	< .01	17.07	9.57	4.68*	< .05
(N)	(28)	(24)			(14)	(14)		
All Years	12.15	4.50	15.04*	< .01	14.05	10.41	1.80	< .25
(N)	(71)	(64)			(34)	(37)		

TABLE 15

Mean Changes in P.M.A. Perceptual Speed Quotients during the Kindergarten or Preschool Year Plus the First Year in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	10.39	14.80	1.36	$<.25$	6.15	15.90	3.52	$<.10$
(N)	(23)	(20)			(13)	(10)		
1963	12.20	18.35	2.80	$<.25$	12.18	12.21	<1.00	—
(N)	(25)	(20)			(11)	(14)		
1964	11.08	16.20	2.48	$<.25$	11.34	10.83	<1.00	—
(N)	(24)	(24)			(12)	(12)		
All Years	11.25	16.43	6.48^*	$<.05$	9.72	12.78	1.19	$>.25$
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	21.36	16.10	2.82	$<.25$	26.00	18.15	2.65	$<.25$
(N)	(22)	(20)			(9)	(13)		
1963	11.67	12.50	<1.00	—	12.00	11.30	<1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	18.18	7.79	7.15^*	$<.05$	19.50	16.86	<1.00	—
(N)	(28)	(24)			(14)	(14)		
All Years	17.24	11.86	6.53^*	$<.05$	18.79	15.81	1.00	$>.25$
(N)	(71)	(64)			(34)	(37)		

TABLE 16

Mean Changes in P.M.A. Perceptual Speed Quotients during the Kindergarten or Preschool Year Plus the First and Second Years in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	10.48	13.40	< 1.00	—	9.15	12.20	< 1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	7.76	10.20	< 1.00	—	10.09	5.93	1.04	> .25
(N)	(25)	(20)			(11)	(14)		
1964	—	—			—	—		
(N)								
All Years	9.06	11.80	1.08	> .25	9.58	8.55	< 1.00	—
(N)	(48)	(40)			(24)	(24)		
Negro Children Who Began In								
1962	16.22	18.35	< 1.00	—	18.56	14.61	< 1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	3.52	10.85	3.30	< .10	5.64	1.20	< 1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	—	—			—	—		
(N)								
All Years	10.02	14.60	2.26	< .25	11.45	8.78	< 1.00	—
(N)	(43)	(40)			(20)	(23)		

is true for the preschool year, the preschool year plus the first year in school, and the preschool year plus the first and second years in school. In fact, when the appropriate groups were combined over all waves, those children who had not attended kindergarten were found to have gained significantly more over the preschool year plus the first year in school than those who had attended.

(2) No consistent programmed instruction effects were found for the white children.

(3) Those Negro children who attended kindergarten during their preschool year showed significantly greater gains over that year and over the preschool year plus the first year in school than did those children who did not attend kindergarten. The change was reversed over the preschool year plus the first and second year in school. None of the differences are statistically significant.

(4) In general Negro children receiving programmed instruction during their preschool year showed greater gains than did those who did not receive programmed instruction. The differences, however, are relatively small and for the most part not significant. This is true for all comparisons.

Analysis of Number Quotient Scores. Table 17 contains the mean quotients made by the various subgroups on the number subtest of the P.M.A. In Tables 18, 19, and 20 are presented the mean differences in scores obtained on successive testings. These data indicate the following:

(1) Those white children who attended the kindergarten during the preschool year gained consistently more during that year than did

TABLE 17

Means of P.M.A. Number Quotients

White Children Who Began In	Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall - Last Preschool Year	Spring - Last Preschool Year	First Grade	Second Grade
1962	78.23	86.69	97.46	97.46	79.20	90.80	100.70	101.40	81.85	87.55	101.15	101.50
(N)	(13)	(13)	(13)	(13)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1963	89.27	97.45	101.36	103.91	88.07	91.64	97.79	102.29	83.65	85.50	92.95	98.40
(N)	(11)	(11)	(11)	(11)	(14)	(14)	(14)	(14)	(20)	(20)	(20)	(20)
1964	80.42	87.92	92.58	——	78.75	81.42	94.42	——	85.29	85.83	94.38	——
(N)	(12)	(12)	(12)		(12)	(12)	(12)		(24)	(24)	(24)	
Total	2964.00	3253.96	3492.90	2409.99	2969.98	3168.00	3509.10	2446.06	5356.96	5520.92	6147.12	3998.00
(N)	(36)	(36)	(36)	(24)	(36)	(36)	(36)	(24)	(64)	(64)	(64)	(40)
X̄	82.33	90.39	97.03	100.42	82.50	88.00	97.48	101.92	83.70	86.26	96.05	99.95
Negro Children Who Began In												
1962	72.78	76.44	86.44	86.78	74.23	77.69	83.23	84.77	73.20	72.40	86.80	91.70
(N)	(9)	(9)	(9)	(9)	(13)	(13)	(13)	(13)	(20)	(20)	(20)	(20)
1963	76.82	85.09	92.82	87.18	74.00	80.50	92.70	87.30	74.00	73.70	89.00	90.35
(N)	(11)	(11)	(11)	(11)	(10)	(10)	(10)	(10)	(20)	(20)	(20)	(20)
1964	67.71	77.50	87.21	——	72.50	76.07	79.14	——	70.46	72.04	84.63	——
(N)	(14)	(14)	(14)		(14)	(14)	(14)		(24)	(24)	(24)	
Total	2447.58	2708.95	3019.92	1740.00	2719.99	2879.95	3116.95	1975.01	4635.04	4650.96	5547.12	3641.00
(N)	(34)	(34)	(34)	(20)	(37)	(37)	(37)	(23)	(64)	(64)	(64)	(40)
X̄	72.00	79.68	88.82	87.00	73.51	77.84	84.24	85.87	72.42	72.67	86.67	91.03

TABLE 18

Mean Changes in P.M.A. Number Quotients during the Kindergarten or Preschool Year

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	9.83	5.70	1.74	<.25	8.46	11.60	<1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	5.60	1.85	2.31	<.25	8.18	3.57	1.93	<.25
(N)	(25)	(20)			(11)	(14)		
1964	5.08	0.54	3.17	<.10	7.50	2.67	1.80	<.25
(N)	(24)	(24)			(12)	(12)		
All Years	6.77	2.56	7.04^*	<.01	8.06	5.50	1.37	<.25
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	3.54	-0.80	1.91	<.25	3.66	3.46	<1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	7.42	-0.30	6.63^*	<.05	8.27	6.50	<1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	6.68	1.58	2.77	<.25	9.79	3.57	2.23	<.25
(N)	(28)	(24)			(14)	(14)		
All Years	5.93	0.25	12.57^*	<.01	7.68	4.33	2.30	<.25
(N)	(71)	(64)			(34)	(37)		

TABLE 19

Mean Changes in P.M.A. Number Quotients during the Kindergarten or Preschool Year Plus the First Year in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	20.22	19.30	<1.00	—	19.23	21.50	<1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	10.76	9.30	<1.00	—	12.09	9.72	<1.00	—
(N)	(25)	(20)			(11)	(14)		
1964	13.91	9.09	2.35	<.25	12.16	15.67	<1.00	—
(N)	(24)	(24)			(12)	(12)		
All Years	14.83	12.35	1.49	<.25	14.70	14.98	<1.00	—
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	10.90	13.60	<1.00	—	13.66	9.00	<1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	17.28	15.00	<1.00	—	16.00	18.70	<1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	13.07	14.17	<1.00	—	19.50	6.64	8.78*	<.01
(N)	(28)	(24)			(14)	(14)		
All Years	13.64	14.25	<1.00	—	16.82	10.73	5.23*	<.0
(N)	(71)	(64)			(34)	(37)		

TABLE 20

Mean Changes in P.M.A. Number Quotients during the Kindergarten or Preschool Year

Plus the First and Second Years in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	20.52	19.65	< 1.00	—	19.23	22.20	< 1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	14.40	14.75	< 1.00	—	14.64	14.22	< 1.00	—
(N)	(25)	(20)			(11)	(14)		
1964	—	—			—	—		
(N)								
All Years	17.33	17.20	< 1.00	—	17.13	17.55	< 1.00	—
(N)	(48)	(40)			(24)	(24)		
Negro Children Who Began In								
1962	11.95	18.50	4.71*	< .05	14.00	10.54	< 1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	11.76	16.35	2.03	< .25	10.36	13.30	< 1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	—	—			—	—		
(N)								
All Years	11.86	17.43	6.48*	< .05	12.00	11.74	< 1.00	—
(N)	(43)	(40)			(20)	(23)		

those who did not attend kindergarten. The difference between the pooled scores of all three waves is statistically significant. Consistent (though non-significant) kindergarten effects were found over the preschool year plus the first year in school, but not over the preschool year plus the first and second years in school.

(2) In the case of the white children, programmed instruction produced no consistent effects for any of the comparisons.

(3) Negro children who attended kindergarten during their preschool year showed consistently greater gains over that year than those who did not. The difference between the gains combined over all waves is statistically significant. Changes over the preschool year plus the first year in school show no consistent effects. Changes over the preschool year plus the first and second year in school, however, consistently favor the non-kindergarten children with the difference between the pooled gains over all waves significantly favoring the non-kindergarten children.

(4) Those Negro children who received programmed instruction during their preschool year showed consistently, but not significantly, greater gains over that year than did those children who did not receive the instruction. A comparison of the combined scores over all waves shows that the children who received programmed instruction gained significantly more over the preschool year plus the first year in school than the non-instructed children. No consistent effects were found over the kindergarten year plus the first and second years in school.

Analysis of P.M.A. Spatial Quotients. In Table 21 are presented the mean quotient scores made on the spatial subtest of the P.M.A. by the various subgroups. Tables 22, 23, and 24 contain the mean differences between the scores obtained at successive test administrations. These tables yield the following information:

(1) Those white children who attended kindergarten during their preschool year consistently gained more than did those children who did not attend. This was true over the preschool year and over the preschool year plus the first year in school. The pooled data show that those who had attended kindergarten gained significantly more over the preschool year plus the first year in school than did those who did not attend. Reversed effects which were consistent, but not significant, were found over the preschool year plus the first and second years in school.

(2) The white children who received programmed instruction consistently gained less over the kindergarten year than did those who did not receive programmed instruction. A comparison of the gains pooled over all waves shows that the children who did not receive programmed instruction during the kindergarten year gained significantly more than those who did. No consistent programmed instruction effects were found over the preschool year plus the first year in school or over the preschool year plus the first and second years in school.

(3) Negro children who attended kindergarten gained significantly more over the preschool year than those who did not attend. The differences are statistically significant for the year 1963-64, for

TABLE [illegible]

Means of P.M.A. Spatial Quotients

White Children Who Began In	Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall - Last Preschool Year	Spring - Last Preschool Year	First Grade	Second Grade
1962	89.31	93.39	102.69	101.92	91.70	103.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(N)	(13)	(13)	(13)	(13)	(10)	(1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1963	95.18	102.18	109.00	107.45	92.00	99.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(N)	(11)	(11)	(11)	(11)	(14)	(1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1964	89.17	89.00	105.00	——	87.17	95.[illegible]	[illegible]	——	[illegible]	[illegible]	[illegible]	——
(N)	(12)	(12)	(12)		(12)	(1[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	
Total	3278.05	3406.05	3793.97	2506.91	3251.04	3564.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(N)	(36)	(36)	(36)	(24)	(36)	(3[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
X̄	91.06	94.61	105.39	104.45	90.31	99.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Negro Children Who Began In												
1962	77.00	85.00	94.56	100.22	77.15	85.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(N)	(9)	(9)	(9)	(9)	(13)	(1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1963	80.00	84.55	93.91	98.18	81.70	92.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(N)	(11)	(11)	(11)	(11)	(10)	(1[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1964	75.36	82.29	83.50	——	80.29	84.[illegible]	[illegible]	——	[illegible]	[illegible]	[illegible]	——
(N)	(14)	(14)	(14)		(14)	(1[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	
Total	2628.04	2847.11	3053.05	1981.96	2944.01	3217.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
(N)	(34)	(34)	(34)	(20)	(37)	(3[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
X̄	77.30	83.74	89.80	99.10	79.57	86.[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

TABLE 22

Mean Changes in P.M.A. Spatial Quotients during the Kindergarten or Preschool Year

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	7.35	5.20	<1.00	—	4.08	11.60	1.99	<.25
(N)	(23)	(20)			(13)	(10)		
1963	7.12	3.65	3.08	<.10	7.00	7.21	<1.00	—
(N)	(25)	(20)			(11)	(14)		
1964	3.96	1.05	1.53	<.25	-0.17	8.08	6.12*	<.05
(N)	(24)	(24)			(12)	(12)		
All Years	6.14	3.16	3.37	<.10	3.55	8.72	5.38*	<.05
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	8.18	4.15	2.83	<.25	8.00	8.31	<1.00	—
(N)	(22)	(20)			(9)	(13)		
1963	7.57	-3.60	15.17*	<.01	4.55	10.90	2.51	<.25
(N)	(21)	(20)			(11)	(10)		
1964	5.46	-0.62	8.88*	<.01	6.93	4.00	1.11	>.25
(N)	(28)	(24)			(14)	(14)		
All Years	6.93	-0.06	23.70*	<.01	6.44	7.38	<1.00	—
(N)	(71)	(64)			(34)	(37)		

TABLE 23

Mean Changes in P.M.A. Spatial Quotients during the Kindergarten
or Preschool Year Plus the First Year in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	13.95	10.60	< 1.00	——	13.38	14.70	< 1.00	——
(N)	(23)	(20)			(13)	(10)		
1963	12.52	7.15	3.32	< .10	13.82	11.50	< 1.00	——
(N)	(25)	(20)			(11)	(14)		
1964	16.58	8.30	5.11*	< .05	15.83	17.33	< 1.00	——
(N)	(24)	(24)			(12)	(12)		
All Years	14.33	8.66	8.17*	< .01	14.33	14.33	< 1.00	——
(N)	(72)	(64)			(36)	(36)		
Negro Children Who Began In								
1962	13.55	12.30	< 1.00	——	17.56	10.77	2.92	< .25
(N)	(22)	(20)			(9)	(13)		
1963	14.00	2.50	10.47*	< .01	13.91	14.10	< 1.00	——
(N)	(21)	(20)			(11)	(10)		
1964	8.99	11.08	< 1.00	——	8.14	9.85	< 1.00	——
(N)	(28)	(24)			(14)	(14)		
All Years	11.89	8.78	2.79	< .10	12.50	11.32	< 1.00	——
(N)	(71)	(64)			(34)	(37)		

TABLE 26

Mean Changes in P.M.A. Spatial Quotients during the Kindergarten or Preschool Year

Plus the First and Second Years in School

	Kindergarten	No Kindergarten	F	P	Programmed Instruction	No Programmed Instruction	F	P
White Children Who Began In								
1962	13.43	14.80	< 1.00	—	12.61	14.50	< 1.00	—
(N)	(23)	(20)			(13)	(10)		
1963	11.56	13.50	< 1.00	—	12.27	11.00	< 1.00	—
(N)	(25)	(20)			(11)	(14)		
1964	—	—			—	—		
(N)								
All Years	12.45	14.15	< 1.00	—	12.45	12.45	< 1.00	—
(N)	(48)	(40)			(24)	(24)		
Negro Children Who Began In								
1962	19.77	18.65	< 1.00	—	23.22	17.38	1.61	< .25
(N)	(22)	(20)			(9)	(13)		
1963	17.47	9.35	3.72	< .10	18.18	16.70	< 1.00	—
(N)	(21)	(20)			(11)	(10)		
1964	—	—			—	—		
(N)								
All Years	18.65	14.00	2.92	< .10	20.45	17.09	< 1.00	—
(N)	(43)	(40)			(20)	(23)		

the year 1964-65, and for all waves combined. No consistent effects were found over the preschool year plus the first year in school. Consistent, though not statistically significant, gains over the preschool year plus the first and second years in school were shown by those children who entered the kindergarten in 1962-63 and in 1963-64.

(4) No significant or consistent effects were found in the case of those Negro children who received programmed instruction.

Summary and Interpretation of Results with Training Procedures Used in 1962, 1963, and 1964.

The previous analysis and description of the data was carried out to call the reader's attention to each comparison and its outcome. Because of its exhaustiveness, some of the major effects and trends were perhaps obscured. Therefore, the comparison data have been reduced and combined into a single table. This has been done by using a single value to represent the outcome of all waves combined for a particular comparison and by replacing the exact values of the comparison differences with one of seven indices. The indices are as follows:

(1) ++ = A difference which is significant at the 1 per cent level in favor of the kindergarten groups (as opposed to the non-kindergarten groups) and in favor of the program-instructed groups (as opposed to the non-program-instructed groups). This difference is based on the total for all waves.

(2) + = A difference which is significant at the 5 per cent level in favor of the kindergarten groups and in favor of the program-instructed groups. This difference is based on the total for all waves.

(3) C = A difference which is consistent, but not significant over all waves in favor of the kindergarten groups and the program-instructed groups. In the case of comparisons over the preschool year and over the preschool year plus the first year in school, this means consistency over three waves. In the case of comparisons over the kindergarten year plus the first and second years in school, it means consistency over two waves.

(4) 0 = No consistent difference over all waves, but the total for all waves is in favor of the kindergarten groups and the program-instructed groups.

(5) 0- = No consistent difference over all waves, but the total for all waves is in favor of the non-kindergarten groups and the non-program-instructed groups.

(6) C- = A difference which is consistent over all waves in favor of the non-kindergarten groups and the non-programmed-instructed groups.

(7) - = A difference which is significant at the 5 per cent level in favor of the non-kindergarten groups and the non-program-instructed groups. This difference is based on the total for all waves.

In Table 25 are presented the differences which have been combined and coded in the manner described above. These data show the following:

(1) In the case of the white children, the kindergarten significantly influenced the Stanford-Binet I.Q.'s but generally had little effect on the P.M.A. quotient scores.

TABLE 25

Summary of Stanford-Binet I.Q. and P.M.A. Quotient Changes for All Waves Combined

White: Kindergarten vs No Kindergarten

	Stanford-Binet	P.M.A. Total	P.M.A. Verbal	P.M.A. Perceptual	P.M.A. Number	P.M.A. Spatial
K	++	C	0	C-	++	C
K + 1	+	C	0-	-	C	++
K + 1 + 2	0	C-	-	C-	0	C-

White: Kindergarten Plus Programmed Instruction vs Kindergarten Only

	Stanford-Binet	P.M.A. Total	P.M.A. Verbal	P.M.A. Perceptual	P.M.A. Number	P.M.A. Spatial
K	0-	0	0	0	C	-
K + 1	0	0	0	0	0	0
K + 1 + 2	C-	0	0	0	0	0

Negro: Kindergarten vs No Kindergarten

	Stanford-Binet	P.M.A. Total	P.M.A. Verbal	P.M.A. Perceptual	P.M.A. Number	P.M.A. Spatial
K	C	++	++	++	++	++
K + 1	0	++	++	+	0-	0
K + 1 + 2	C-	C-	C-	C-	-	C

Negro: Kindergarten Plus Programmed Instruction vs Kindergarten Only

	Stanford-Binet	P.M.A. Total	P.M.A. Verbal	P.M.A. Perceptual	P.M.A. Number	P.M.A. Spatial
K	0	+	0	0	C	0
K + 1	0	++	+	C	+	0
K + 1 + 2	0	+	C	C	0	C

(2) Programmed instruction had virtually no effect on the Stanford-Binet I.Q.'s or the P.M.A. quotients of the white children.

(3) In the case of the Negro children, kindergarten experience had no effect on the Stanford-Binet I.Q.'s but had a highly significent effect on the P.M.A. quotients.

(4) Programmed instruction in the case of the Negro children had no effect on the Stanford-Binet I.Q.'s but significantly influenced the total, verbal, and number quotients of the P.M.A.

(5) The differential gains produced by kindergarten experience in the case of the white children grew smaller over time and in many instances were reversed by the end of the second year in school.

(6) The differential gains produced by kindergarten experience in the case of the Negro children also grew smaller over time. Although the effects were more persistent for the Negro children than they were for the white, they too were reversed by the end of the second year in school.

(7) The differential gains produced by the programmed instruction in the case of the Negro children did not follow the simple temporal course followed by the differential gains produced by kindergarten experience. Significant gains, for example, often did not occur over the kindergarten year, when the training was given, but rather over the kindergarten year plus the first year in school. Moreover, although the differential gains had decreased by the second year in school, no reversals occurred.

Relation of Changes to Original Intellective Level

In the analyses just discussed, only the main effects were reported. Gains over the various years were analyzed, however, not only in regard to main effects but also in regard to original intellective levels. In almost every instance there was a significant levels effect, with those subjects initially scoring below the median gaining significantly more than those scoring above.

These findings, however, did not seem interesting because they were precisely what one would have predicted, given what is known about regression toward the mean. In addition, the levels effect was based not only on the data of the kindergarten children and the children who received special instruction, but on the data of the children who did not attend kindergarten as well. To be sure, kindergarten effects were examined and reported, but the effects of major interest were those produced by the special instruction, and these did not involve the non-kindergarten children. What we were interested in, therefore, were the interactions between original levels and type of training, i.e. programmed instruction vs no programmed instruction. Such interactions would permit us to determine whether differences between program-instructed and non-program-instructed children were greater for those children who initially scored below the median or greater for those who initially scored above.

When the data were analyzed, only one such interaction was found to be significant. This interaction was for the Negro children and was for gains made on the P.M.A. total quotient over the kindergarten year plus the first year in school. After finding this significant interaction, we carried out separate analyses on the gains made by the children who were initially above the median of the P.M.A. total quotients and by those who were initially below. This yielded the finding that the children initially above the median who received both programmed instruction and kindergarten experience gained significantly more than those who had received only kindergarten experience ($F = 12.98$, df = 1 and 33, $p < .01$). In contrast, no such significant difference was found for those children who initially scored below the median ($F = 1.35$, df = 1 and 33, $p < 0.25$).

Two comments regarding this finding seem indicated. First, the programmed instruction effect for the Negro children on the P.M.A. total quotient over the kindergarten year plus the first year in school was our largest and perhaps our most reliable effect. Had the effects on the subtests been larger and more reliable, they too might have yielded significant interactions.

A second point which must be made is that many of the Negro children had very low initial scores on the P.M.A., so low in fact that the test norms had no values for approximately one-half of the initial raw scores. In these instances the raw scores were arbitrarily assigned a quotient value of 50. This procedure, though necessary for data comparison, had the possible disadvantage of reducing our gains, particularly in the case of the subjects who had initially very low scores. This possible underestimation of the gains made by the Negro children who initially fell below the median also might have produced the significant interaction and thus complicated our interpretation of it.

Effects of Kindergarten Experience and of Programmed Instruction on Later Academic Performance

A question raised earlier is whether or not kindergarten experience and kindergarten experience plus special programmed instruction would influence later academic achievement. Answers to this question were supplied by two kinds of data. These are Stanford Achievement Test scores and academic grades.

The Stanford Achievement Test was administered twice, namely, in the spring at the end of the 1963-64 academic year and in the following spring at the end of the 1964-65 academic year. In general, it proved to be an unsatisfactory test for most of the children because of the complicated instructions. Therefore, it was not given in the spring of the 1965-66 academic year.

In Table 26 are presented the means of the battery medians made by the various groups. Table 27 contains the differences among the appropriate groups together with corresponding F's and p-values. These data indicate that programmed instruction during the kindergarten year had no significant effect on Stanford Achievement Test scores. In regard to kindergarten effects, they reveal what to us at the time seemed like unexpected outcomes. These are the following:

(1) White children who had previously not attended kindergarten scored significantly higher at the end of the first grade and at the end of the second grade than did white children who had attended

TABLE 26

Means of Stanford Achievement Test Battery Median Scores

	Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
White Children Who Began In	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall - Last Preschool Year	Spring - Last Preschool Year	First Grade	Second Grade
1962	-----	-----	2.09	3.02	-----	-----	2.38	3.30	-----	-----	2.75	3.74
(N)			(13)	(13)			(10)	(10)			(20)	(20)
1963	-----	-----	2.48	-----	-----	-----	2.31	-----	-----	-----	2.71	-----
(N)			(11)				(14)				(20)	
Total	-----	-----	2.27	3.02	-----	-----	2.34	3.30	-----	-----	2.73	3.74
(N)			(24)	(13)			(24)	(10)			(40)	(20)
Negro Children Who Began In												
1962	-----	-----	1.77	2.53	-----	-----	1.74	2.29	-----	-----	1.90	2.87
(N)			(9)	(9)			(14)	(14)			(20)	(20)
1963	-----	-----	2.04	-----	-----	-----	1.90	-----	-----	-----	1.87	-----
(N)			(10)				(10)				(20)	
Total	-----	-----	1.91	2.53	-----	-----	1.80	2.29	-----	-----	1.88	2.87
(N)			(19)	(9)			(24)	(14)			(40)	(20)

TABLE 27

Differences in Means of Stanford Achievement Test Battery Median Scores

	White Children			Negro Children		
	Differences	F	P	Differences	F	P
First Grade Differences						
Kindergarten Minus No Kindergarten	-0.42	9.69^*	$< .01$	-0.03	< 1.00	—
Programmed Instruction Minus No Programmed Instruction	-0.07	< 1.00	—	0.11	< 1.00	—
Second Grade Differences						
Kindergarten Minus No Kindergarten	-0.60	5.79^*	$< .05$	-0.48	6.06^*	$< .05$
Programmed Instruction Minus No Programmed Instruction	-0.28	< 1.00	—	0.24	< 1.00	—

kindergarten.

(2) Negro children who had not attended kindergarten scored significantly higher at the end of the second grade than did those Negro children who had attended kindergarten.

The general finding that the non-kindergarten children scored higher on the Stanford Achievement Test at the end of the first and second grades, while disappointing, is no longer surprising. It is very much in keeping with the declining gains and reversed effects seen in Table 25. The major disappointment with the instrument is that it was too insensitive to detect any of the programmed instruction effects in the Negro children which were reflected by the P.M.A.

The second method by which school achievement was assessed was through the use of academic grades. Unfortunately, these too proved to be of little value, except perhaps to point up difficulties which often arise in their use. The first problem encountered was the unavailability of grades in the non-kindergarten schools. Obviously, comparisons of grades given by different teachers at different schools are of limited value at best, but their unavailability in two schools eliminated any chance of comparison. Problems also arose in regard to grades given at the two schools which housed the kindergartens. For example, the cumulative grade records of some children were missing. Similarly, no grades were recorded on the cumulative records of some children. As a consequence, first-grade records of twelve children, for whom all other data were complete, were not available. In addition, nine second-grade records for similar children were missing. This left totals of 69 and 45 in the first and second grades respectively of the white school and 62 and 37 in the same grades at the Negro school.

A somewhat less difficult problem that arose was how to arrive at appropriate indices which would summarize these grades. Arbitrarily this was done by combining grades in such subjects as reading and spelling into a single verbal score. A quantitative score was obtained by using the grade in arithmetic. Although other grades were given, it was felt that these two yielded a valid picture of each child's overall academic performance.

In Tables 28 and 29 are presented the numbers of children making A's, B's, C's, and D's in the verbal and quantitative areas. Satisfactory grades are represented by A's and B's. A grade of C constituted a low pass. Failure in an area is signified by a D. Some instructors also gave E's and F's, but these grades had no official status according to the legend on the report card. Inasmuch as they too represented failing efforts, we pooled them with the D's. An inspection of the data of both tables quickly reveals that no significant differences were produced by the programmed instruction. This has been further supported by chi square tests. The only interesting aspect of the data is that the differences between the academic grades made by the Negro and white children parallel rather closely the differences found in their Stanford-Binet and P.M.A. test scores. Note also that no Negro child in the first grade made an A in the verbal area during this three year period.

TABLE 28

Academic Grades Made in The First Grade

	A	B	C	D	Total
White					
Verbal	A	B	C	D	Total
Programmed Instruction	6	11	11	7	35
No Programmed Instruction	8	14	7	5	34
Quantitative	A	B	C	D	Total
Programmed Instruction	8	12	8	7	35
No Programmed Instruction	10	12	6	6	34
Negro					
Verbal	A	B	C	D	Total
Programmed Instruction	0	8	19	5	32
No Programmed Instruction	0	8	14	8	30
Quantitative	A	B	C	D	Total
Programmed Instruction	2	16	10	4	32
No Programmed Instruction	0	13	8	9	30

TABLE 29

Academic Grades Made in the Second Grade

White

Verbal	A	B	C	D	Total
Programmed Instruction	10	7	5	0	22
No Programmed Instruction	14	4	4	1	23

Quantitative	A	B	C	D	Total
Programmed Instruction	11	8	3	0	22
No Programmed Instruction	15	6	2	0	23

Negro

Verbal	A	B	C	D	Total
Programmed Instruction	2	9	3	4	18
No Programmed Instruction	3	6	9	1	19

Quantitative	A	B	C	D	Total
Programmed Instruction	2	7	6	3	18
No Programmed Instruction	2	6	10	1	19

Analysis of Results Obtained With the Training Procedures Used in 1965

Results obtained with the matching-to-sample training during 1962, 1963, and 1964, although gratifying in some respects, were disappointing in others. The special instructional procedures, for example, had no effect on any of the test scores of the white children. Similarly, they did not influence the Stanford-Binet I.Q.'s of the Negro children. Finally, they did not effect differential gains on the Stanford Achievement Test or on academic grades. It seemed, therefore, that a modification of our procedure was indicated.

In order to determine what modifications to make, we carried out more detailed analyses of our data. One such analysis entailed an examination of each item in the Stanford-Binet test between the five- and eight-year levels. Tables 30, 31, 32, and 33 contain the results of this analysis. More specifically these tables present the numbers and percentages of children in each group passing each item. Table 30 contains the data from the fifth-year level. Tables 31, 32, and 33 contain the results for the sixth-, seventh-, and eighth- year levels respectively.

The data of Table 30 indicate few if any consistent differences between the various groups. An inspection of Table 31, which contains the six-year items, however, yields an immediately obvious difference. This difference is between the Negro and white children on Item VI-1 which is a vocabulary item. Fewer Negro children passed this item originally, and their initial disadvantage was never completely overcome. The data of Tables 32 and 33 depict this difference even more

TABLE 30

Numbers and Percentages of Children at Each Grade Level Who Passed Individual Fifth-Year Items on the Stanford-Binet Test

(Data for Children Who Entered the Experiment in 1962, 1963, 1964)

			Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
			Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade
Item I	WHITE	N Passing	22	35	36	24	25	34	36	24	53	60	64	40
		% Passing	61.11	97.22	100.00	100.00	69.44	94.44	100.00	100.00	82.81	93.75	100.00	100.00
	NEGRO	N Passing	21	31	34	20	22	33	37	23	37	46	64	40
		% Passing	61.76	91.18	100.00	100.00	59.46	89.19	100.00	100.00	57.81	71.88	100.00	100.00
Item II	WHITE	N Passing	26	33	36	24	27	35	36	24	52	57	63	39
		% Passing	72.22	91.67	100.00	100.00	75.00	97.22	100.00	100.00	81.25	89.06	98.44	97.50
	NEGRO	N Passing	14	31	34	20	25	34	35	23	29	41	59	39
		% Passing	41.18	91.18	100.00	100.00	67.57	91.89	94.59	100.00	45.31	64.06	92.19	97.50
Item III	WHITE	N Passing	28	35	36	24	34	35	36	24	58	63	64	40
		% Passing	77.78	97.22	100.00	100.00	94.44	97.22	100.00	100.00	90.63	98.44	100.00	100.00
	NEGRO	N Passing	34	33	34	20	37	37	37	23	55	61	64	40
		% Passing	100.00	97.06	100.00	100.00	100.00	100.00	100.00	100.00	85.94	95.31	100.00	100.00
Item IV	WHITE	N Passing	21	31	36	24	23	33	36	24	42	54	64	40
		% Passing	58.33	86.11	100.00	100.00	63.89	91.67	100.00	100.00	65.63	84.38	100.00	100.00
	NEGRO	N Passing	20	28	33	20	15	31	35	23	25	36	62	40
		% Passing	58.82	82.35	97.06	100.00	40.54	83.78	97.30	100.00	39.06	56.25	96.88	100.00
Item V	WHITE	N Passing	31	34	36	24	25	33	36	24	53	56	64	40
		% Passing	86.11	94.44	100.00	100.00	69.44	91.67	100.00	100.00	82.81	87.50	100.00	100.00
	NEGRO	N Passing	26	33	34	20	24	36	37	23	44	56	64	39
		% Passing	76.47	97.06	100.00	100.00	64.83	97.30	100.00	100.00	68.75	87.50	100.00	97.50
Item VI	WHITE	N Passing	11	30	36	24	10	28	36	24	27	45	61	39
		% Passing	30.56	83.33	100.00	100.00	27.78	77.78	100.00	100.00	42.19	70.31	95.31	97.50
	NEGRO	N Passing	18	32	33	20	24	31	35	23	31	46	60	39
		% Passing	52.94	94.12	97.06	100.00	64.83	83.76	94.59	100.00	48.44	71.88	93.75	97.50

TABLE 31

Numbers and Percentages of Children at Each Grade Level Who Passed Individual Sixth-Year Items on the Stanford-Binet Test

(Data for Children Who Entered the Experiment in 1962, 1963, 1964)

			Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
			Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade
Item I	WHITE	N Passing	14	26	34	24	13	29	36	24	25	40	59	40
		% Passing	38.89	72.22	94.44	100.00	36.11	80.56	100.00	100.00	39.06	62.50	92.19	100.00
	NEGRO	N Passing	3	8	15	13	4	10	19	17	7	11	22	32
		% Passing	8.82	23.53	44.12	65.00	10.81	27.03	51.35	73.91	10.94	17.19	34.38	80.00
Item II	WHITE	N Passing	15	25	33	23	17	27	34	22	30	41	58	40
		% Passing	41.67	69.44	91.67	95.83	47.22	75.00	94.44	91.67	46.88	79.69	90.63	100.00
	NEGRO	N Passing	17	24	26	20	15	24	30	21	22	28	53	39
		% Passing	50.00	70.59	76.47	100.00	43.24	64.83	81.08	81.30	34.38	43.75	82.81	97.50
Item III	WHITE	N Passing	19	30	34	24	19	31	35	24	43	51	62	40
		% Passing	52.78	83.33	94.44	100.00	52.78	86.11	97.22	100.00	67.19	79.69	96.88	100.00
	NEGRO	N Passing	13	23	28	20	14	23	31	22	22	32	49	39
		% Passing	38.24	67.65	82.35	100.00	37.84	62.16	83.78	95.65	34.38	50.00	76.56	97.50
Item IV	WHITE	N Passing	12	23	36	23	8	25	33	24	16	44	59	40
		% Passing	33.33	63.89	100.00	95.83	22.22	69.44	91.67	100.00	25.00	68.85	92.19	100.00
	NEGRO	N Passing	6	21	34	20	4	21	34	23	6	16	59	40
		% Passing	17.65	61.76	100.00	100.00	10.81	56.76	91.89	100.00	9.38	25.00	92.19	100.00
Item V	WHITE	N Passing	9	22	34	24	9	23	34	24	18	29	59	40
		% Passing	25.00	61.11	94.44	100.00	25.00	63.89	94.44	100.00	28.13	45.31	92.19	100.00
	NEGRO	N Passing	6	20	31	20	8	14	29	19	11	28	48	35
		% Passing	17.65	58.82	91.18	100.00	21.62	37.84	78.38	82.61	17.19	43.75	75.00	87.50
Item VI	WHITE	N Passing	25	30	35	24	25	32	36	24	45	52	62	39
		% Passing	69.44	83.33	97.22	100.00	69.44	88.89	100.00	100.00	70.31	81.25	96.88	97.50
	NEGRO	N Passing	19	23	28	20	20	25	35	21	26	37	56	39
		% Passing	55.83	67.65	82.35	100.00	54.05	67.57	94.59	91.30	40.63	57.81	87.50	97.50

TABLE 32

Numbers and Percentages of Children at Each Grade Level Who Passed Individual Seventh-Year Items on the Stanford-Binet Test

(Data For Children Who Entered the Experiment in 1962, 1963, 1964)

			Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
			Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade
Item I	WHITE	N Passing	7	18	25	21	6	12	22	23	11	25	43	35
		% Passing	19.44	50.00	68.44	87.50	16.67	33.33	61.11	95.83	17.19	29.06	67.19	87.50
	NEGRO	N Passing	0	4	10	13	0	4	16	14	3	8	13	20
		% Passing	00.00	11.76	29.41	65.00	00.00	10.81	43.24	60.87	4.69	12.50	20.31	50.00
Item II	WHITE	N Passing	6	11	25	21	3	12	24	23	16	25	45	36
		% Passing	16.67	30.56	69.44	87.50	8.33	33.33	66.67	95.83	25.00	39.06	70.31	90.00
	NEGRO	N Passing	6	10	18	13	6	6	15	14	7	13	25	21
		% Passing	17.65	29.41	52.94	65.00	16.22	16.22	40.54	60.87	10.94	20.31	39.06	52.50
Item III	WHITE	N Passing	2	12	26	23	3	12	28	21	7	12	53	38
		% Passing	5.71	33.33	72.22	95.83	8.33	33.33	77.78	87.50	10.94	18.75	82.81	95.00
	NEGRO	N Passing	0	0	8	13	1	4	5	12	0	0	16	16
		% Passing	0.00	0.00	23.53	65.00	2.70	10.81	13.51	52.17	0.00	0.00	25.00	40.00
Item IV	WHITE	N Passing	8	15	26	23	6	19	32	24	20	27	47	34
		% Passing	22.22	41.67	72.22	95.83	16.67	52.78	88.89	100.00	31.25	42.19	73.44	85.00
	NEGRO	N Passing	3	11	20	14	4	6	15	16	6	11	27	25
		% Passing	8.82	32.35	58.82	70.00	10.81	16.22	40.54	9.57	9.38	17.19	42.19	62.50
Item V	WHITE	N Passing	6	9	21	19	5	12	20	22	14	24	42	37
		% Passing	16.67	25.00	58.33	79.17	13.89	33.33	55.56	91.67	21.88	37.50	65.63	92.50
	NEGRO	N Passing	3	11	25	17	6	10	20	18	5	12	22	27
		% Passing	8.82	32.35	73.53	85.00	16.22	27.03	54.05	78.26	7.81	18.75	34.48	67.50
Item VI	WHITE	N Passing	2	5	18	17	0	5	14	18	4	9	29	35
		% Passing	5.71	13.89	50.00	70.83	0.00	13.89	38.89	75.00	6.25	14.06	45.31	87.50
	NEGRO	N Passing	1	7	14	14	1	4	17	14	3	8	22	27
		% Passing	2.94	20.59	41.18	70.00	2.70	10.81	45.95	60.87	4.69	12.50	34.38	67.50

TABLE 33

Numbers and Percentages of Children at Each Grade Level Who Passed Individual Eight-Year Items on the Stanford-Binet Test

(Data For Children Who Entered the Experiment in 1962, 1963, 1964)

			Kindergarten Plus Programmed Instruction				Kindergarten - No Programmed Instruction				No Kindergarten or Programmed Instruction			
			Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade	Fall Kindergarten	Spring Kindergarten	First Grade	Second Grade
Item I	WHITE	N Passing	3	9	20	20	5	11	25	23	4	17	43	35
		% Passing	8.33	25.00	55.56	83.33	13.89	30.56	69.44	95.83	6.25	26.56	67.19	87.50
	NEGRO	N Passing	0	1	2	7	0	0	1	5	0	2	6	13
		% Passing	0.00	2.94	5.88	35.00	0.00	0.00	2.70	21.74	0.00	3.13	9.38	32.50
Item II	WHITE	N Passing	2	15	21	20	4	13	19	23	13	17	36	35
		% Passing	5.56	41.67	58.33	83.33	11.11	36.11	52.78	95.83	20.31	26.56	56.25	87.50
	NEGRO	N Passing	0	2	15	16	1	1	13	16	2	4	19	27
		% Passing	0.00	5.88	44.12	80.00	2.70	2.70	35.14	69.57	3.13	6.25	29.69	67.50
Item III	WHITE	N Passing	2	3	10	11	1	4	12	15	1	3	22	31
		% Passing	5.56	8.33	27.78	45.83	2.78	11.11	33.33	62.50	1.56	4.69	34.38	77.50
	NEGRO	N Passing	0	0	2	6	0	0	5	4	0	1	4	13
		% Passing	0.00	0.00	5.88	30.00	0.00	0.00	13.51	17.39	0.00	1.56	6.25	32.50
Item IV	WHITE	N Passing	3	4	23	18	1	7	18	21	3	9	33	31
		% Passing	8.33	11.11	63.89	75.00	2.78	19.44	50.00	87.50	4.69	14.06	51.56	77.50
	NEGRO	N Passing	0	2	12	9	0	0	6	7	0	0	9	21
		% Passing	0.00	5.88	35.29	45.00	0.00	0.00	16.22	30.43	0.00	0.00	14.06	52.50
Item V	WHITE	N Passing	2	2	17	18	1	8	14	19	6	15	32	32
		% Passing	5.56	5.56	47.22	75.00	2.78	22.22	38.89	79.17	9.38	23.44	50.00	80.00
	NEGRO	N Passing	0	2	7	10	0	0	5	9	3	3	5	11
		% Passing	0.00	5.88	20.59	50.00	0.00	0.00	13.51	39.13	4.69	4.69	7.81	17.19
Item VI	WHITE	N Passing	1	7	18	19	0	11	22	21	5	5	32	35
		% Passing	2.78	19.44	50.00	79.17	0.00	30.56	61.11	87.50	7.81	7.81	50.00	87.50
	NEGRO	N Passing	0	0	13	12	0	0	12	11	0	0	8	27
		% Passing	0.00	0.00	38.24	60.00	0.00	0.00	32.43	47.83	0.00	0.00	12.50	67.50

strikingly. Thus, on at least 10 of 12 items at the seventh and eighth year levels greater proportions of the white children than of the Negro children pass. This raises a question as to the nature of the items. It is difficult, of course, to specify their precise composition, but with the possible exception of Item VII-3 (copying a diamond) all entail verbal skills. Thus, to point out similarities or differences between objects the child must have developed both some general intraverbal skills and some competance in tacting these objects. The same is true for comprehension and verbal absurdities. Even the memory item may be viewed as an assessor of intraverbal strength. It appears, therefore, that the relatively poorer performance of the Negro children might have been caused by the increasing verbal demands made by the test items, which unfortunately were not met. In general it seems reasonable to consider this limitation as a possible basis for the poorer performance of all of the children on the test items at the higher age levels.

In view of the results of our analyses we decided to reduce the amount of training given by means of the matching-to-sample programs and procedures and to institute training procedures which would give greater amounts of training in the various verbal skills. This was done by means of the typewriter complexes and programs previously described in the procedure section.

Analysis of Stanford-Binet and P.M.A. data. Tables 34, 35, and 36 contain the mean Stanford-Binet I.Q.'s and P.M.A. Quotients made

TABLE 34

Means of Stanford-Binet I.Q.'s and P.M.A. Total Quotients

Means of Stanford-Binet I.Q.'s

	Kindergarten Plus Programmed Instruction		Kindergarten - No Programmed Instruction	
White Children Who Began In	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten
1965	101.00	110.90	101.46	107.77
(N)	(10)	(10)	(13)	(13)
Negro Children Who Began In				
1965	91.89	96.56	90.28	94.39
(N)	(9)	(9)	(18)	(18)

Means of P.M.A. Total Quotients

White Children Who Began In	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten
1965	83.10	95.60	80.77	94.92
(N)	(10)	(10)	(13)	(13)
Negro Children Who Began In				
1965	59.56	77.33	56.22	70.89
(N)	(9)	(9)	(18)	(18)

TABLE 35

Means of P.M.A. Verbal and Perceptual Quotients

Means of P.M.A. Verbal Quotients

White Children Who Began In	Kindergarten Plus Programmed Instruction		Kindergarten - No Programmed Instruction	
	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten
1965	85.70	95.70	91.85	97.10
(N)	(10)	(10)	(13)	(13)
Negro Children Who Began In				
1965	78.67	79.89	77.89	76.44
(N)	(9)	(9)	(18)	(18)

Means of P.M.A. Perceptual Quotients

White Children Who Began In	Kindergarten Plus Programmed Instruction		Kindergarten - No Programmed Instruction	
	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten
1965	94.10	100.50	97.77	104.77
(N)	(10)	(10)	(13)	(13)
Negro Children Who Began In				
1965	85.56	91.11	79.28	88.67
(N)	(9)	(9)	(18)	(18)

TABLE 36

Means of P.M.A. Number and Spatial Quotients

Means of P.M.A. Number Quotients

White Children Who Began In	Kindergarten Plus Programmed Instruction		Kindergarten - No Programmed Instruction	
	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten
1965	86.90	95.40	82.23	86.77
(N)	(10)	(10)	(13)	(13)
Negro Children Who Began In				
1965	71.56	81.44	69.89	76.17
(N)	(9)	(9)	(18)	(18)

Means of P.M.A. Spatial Quotients

White Children Who Began In	Kindergarten Plus Programmed Instruction		Kindergarten - No Programmed Instruction	
	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten
1965	90.50	94.30	87.92	95.00
(N)	(10)	(10)	(13)	(13)
Negro Children Who Began In				
1965	78.67	85.67	78.39	83.28
(N)	(9)	(9)	(18)	(18)

by the various groups. In Tables 37, 38, and 39 are presented the mean differences together with their appropriate F- and P- values. These data indicate that neither in the case of the Negro children nor of the white children did the special typewriter instruction produce gains which significantly differed from those produced by normal kindergarten experience. A re-examination of the raw data, however, indicated some unusual distributional properties, especially in the case of the groups not receiving typewriter instruction. In the case of the white children, for example, all of the children receiving typewriter instruction showed gains, in fact nine of the ten subjects showed gains of six or more I.Q. points. In contrast, only four of the control subjects showed gains of this magnitude. When a test of significance was performed on the distribution of changes above and below the median change, a significant chi square was obtained ($X^2 = 5.48$, $p < .02$), thus indicating that the typewriter instruction, in conjunction with kindergarten experience, had produced significantly more gains beyond the median gain than had kindergarten experience alone.

In Tables 40 and 41 are presented analyses of individual Stanford-Binet items from the fifth- through the eighth-year levels. These tables are identical to Tables 30, 31, 32, and 33 except that Tables 40 and 41 contain data collected during the 1965-66 academic year. The data of these tables suggests that the typewriter training had its greatest effect on the items of the eighth-year level. See especially the effect on Item VIII-1, a vocabulary item.

When the chi square test was applied to gains on the P.M.A. verbal quotients, essentially the same outcome was obtained. Again the children

TABLE 37

Mean Changes in Stanford-Binet I.Q.'s and P.M.A. Total Quotients during the Kindergarten Year

Mean Changes in Stanford-Binet I.Q.'s

White Children Who Began In	Programmed Instruction	No Programmed Instruction	F	P
1965	9.90	6.31	< 1.00	—
(N)	(10)	(13)		
Negro Children Who Began In				
1965	4.67	4.11	< 1.00	—

Mean Changes in P.M.A. Total Quotients

White Children Who Began In	Programmed Instruction	No Programmed Instruction	F	P
1965	12.50	14.67	< 1.00	—
(N)	(10)	(13)		
Negro Children Who Began In				
1965	17.77	14.67	< 1.00	—
(N)	(9)	(18)		

TABLE 38

Mean Changes in P.M.A. Verbal Quotients and P.M.A. Perceptual Quotients during the Kindergarten Year

Mean Changes in P.M.A. Verbal Quotients

White Children Who Began In	Programmed Instruction	No Programmed Instruction	F	P
1965	10.00	5.25	< 1.00	—
(N)	(10)	(13)		
Negro Children Who Began In				
1965	1.22	-1.45	< 1.00	—
(N)	(9)	(18)		

Mean Changes in P.M.A. Perceptual Quotients

White Children Who Began In	Programmed Instruction	No Programmed Instruction	F	P
1965	6.40	7.00	< 1.00	—
(N)	(10)	(13)		
Negro Children Who Began In				
1965	5.55	9.39	< 1.00	—
(N)	(9)	(18)		

TABLE 39

Mean Changes in P.M.A. Number Quotients and P.M.A. Spatial Quotients during the Kindergarten Year

Mean Changes in P.M.A. Number Quotients

White Children Who Began In	Programmed Instruction	No Programmed Instruction	F	P
1965	8.50	4.54	< 1.00	—
(N)	(10)	(13)		
Negro Children Who Began In				
1965	9.88	6.28	< 1.00	—
(N)	(9)	(18)		

Mean Changes in P.M.A. Spatial Quotients

White Children Who Began In	Programmed Instruction	No Programmed Instruction	F	P
1965	3.80	7.08	< 1.00	—
(N)	(10)	(13)		
Negro Children Who Began In				
1965	7.00	4.89	< 1.00	—
(N)	(9)	(18)		

TABLE 40

Numbers and Percentages of Children in the 1965-66 Kindergartens Who Passed Individual Items at Each Age Level of the Stanford-Binet Test

			YEAR V				YEAR VI			
			Programmed Instruction		No Programmed Instruction		Programmed Instruction		No Programmed Instruction	
			Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten
Item I	WHITE	N Passing	8	10	11	12	5	9	8	12
		% Passing	80.00	100.00	84.62	92.31	50.00	90.00	61.54	92.31
	NEGRO	N Passing	5	9	5	15	1	5	0	4
		% Passing	55.56	100.00	27.78	83.33	11.11	55.56	0.00	22.22
Item II	WHITE	N Passing	10	10	7	13	7	8	6	7
		% Passing	100.00	100.00	53.85	100.00	70.00	80.00	46.15	53.85
	NEGRO	N Passing	5	9	7	17	2	7	4	11
		% Passing	55.56	100.00	38.89	94.44	22.22	77.78	22.22	61.11
Item III	WHITE	N Passing	10	10	13	13	8	9	10	13
		% Passing	100.00	100.00	100.00	100.00	80.00	90.00	76.92	100.00
	NEGRO	N Passing	9	9	18	18	3	7	1	11
		% Passing	100.00	100.00	100.00	100.00	33.33	77.78	5.56	61.11
Item IV	WHITE	N Passing	7	10	9	12	3	9	3	11
		% Passing	70.00	100.00	69.23	92.31	30.00	90.00	23.08	84.62
	NEGRO	N Passing	3	9	3	18	0	9	1	10
		% Passing	33.33	100.00	16.67	100.00	0.00	100.00	5.56	55.56
Item V	WHITE	N Passing	8	10	12	13	2	9	4	10
		% Passing	80.00	100.00	92.31	100.00	20.00	90.00	30.77	76.92
	NEGRO	N Passing	8	9	12	18	2	6	4	9
		% Passing	88.89	100.00	66.67	100.00	22.22	66.67	22.22	50.00
Item VI	WHITE	N Passing	2	10	3	9	8	10	6	13
		% Passing	20.00	100.00	23.08	69.23	80.00	100.00	46.15	100.00
	NEGRO	N Passing	5	9	8	16	3	8	7	10
		% Passing	55.56	100.00	44.44	88.89	33.33	88.89	38.89	55.56

TABLE 41

Numbers and Percentages of Children in the 1965-66 Kindergartens Who Passed Individual Items at Each Age Level of the Stanford-Binet Test

			YEAR VII				YEAR VIII			
			Programmed Instruction		No Programmed Instruction		Programmed Instruction		No Programmed Instruction	
			Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten	Fall Kindergarten	Spring Kindergarten
Item I	WHITE	N Passing	2	4	1	5	2	7	2	3
		% Passing	20.00	40.00	7.69	38.46	20.00	70.00	15.38	23.08
	NEGRO	N Passing	0	0	0	1	0	0	0	0
		% Passing	0.00	0.00	0.00	5.56	0.00	0.00	0.00	0.00
Item II	WHITE	N Passing	3	5	1	5	2	5	2	2
		% Passing	30.00	50.00	7.69	38.46	20.00	50.00	15.38	15.38
	NEGRO	N Passing	0	1	1	4	0	0	0	3
		% Passing	0.00	11.11	5.56	22.22	0.00	0.00	0.00	16.67
Item III	WHITE	N Passing	1	4	0	3	0	3	0	1
		% Passing	10.00	40.00	0.00	23.08	0.00	30.00	0.00	7.69
	NEGRO	N Passing	0	0	0	1	0	0	0	0
		% Passing	0.00	0.00	0.00	5.56	0.00	0.00	0.00	0.00
Item IV	WHITE	N Passing	4	7	4	9	0	2	0	1
		% Passing	40.00	70.00	30.77	69.23	0.00	20.00	0.00	7.69
	NEGRO	N Passing	1	2	0	2	0	0	0	0
		% Passing	11.11	22.22	0.00	11.11	0.00	0.00	0.00	0.00
Item V	WHITE	N Passing	1	3	0	4	1	3	0	2
		% Passing	10.00	30.00	0.00	30.77	10.00	30.00	0.00	15.38
	NEGRO	N Passing	0	3	1	8	0	0	0	0
		% Passing	0.00	33.33	5.56	44.44	0.00	0.00	0.00	0.00
Item VI	WHITE	N Passing	0	1	0	2	0	1	0	0
		% Passing	0.00	10.00	0.00	15.38	0.00	10.00	0.00	0.00
	NEGRO	N Passing	0	0	0	1	0	0	0	0
		% Passing	0.00	0.00	0.00	5.56	0.00	0.00	0.00	0.00

receiving both kindergarten experience and typewriter instruction showed significantly more gains beyond the median than did those who received only the kindergarten experience ($X^2 = 3.94$, $p < .05$). In order to make certain that such differences were not present in the data of the first three years, we re-analyzed in this manner the earlier Stanford-Binet and P.M.A. Verbal gains of the white children. In neither case was statistical significance obtained.

When chi square tests were applied to the other gains generated by the white children during the 1965-66 academic year, none were found to be significant or even to approach significance. Re-examination of the gains generated by the Negro children suggested no need for additional analyses. Indeed the effects of the typewriter procedure on the performance gains of the Negro children were very disappointing in a number of ways. Virtually, all gains produced by the typewriter were smaller than the gains previously produced by the matching-to-sample procedure.

The results of these analyses strongly suggest that the typewriter procedure was appropriate for the white children. This is based in large measure on the fact that the typewriter procedure produced the first significant increases found in the white children and with the Stanford-Binet test. By the same token this same instruction seems less appropriate for the Negro children than does the matching-to-sample training. In the forth-coming year the matching-to-sample training will be reinstituted for the Negro children. Typewriter training will again be given, but will be delayed until they have completed the matching-to-sample training.

Analysis of specific achievement tests. Because we did not believe that the more general standard tests such as the Stanford-Binet and P.M.A. were detecting all of the effects of the typewriter training, we constructed and administered a number of highly specific achievement tests. Mr. Robert Rudolph had the principal responsibility for this endeavor, and the data which I shall report now are a part of those which he collected.

One of the tests which Rudolph administered was a letter identification test. He found that those children who received the special typewriter instruction in conjunction with kindergarten experience identified significently more letters than did those children who had only kindergarten experience. This was true for both the Negro children ($t = 3.18$, $p < .01$) and the white children ($t = 4.08$, $p < .01$). The same held true for an animal identification test with all experimental groups identifying significantly more animals than the controls. In this case the t for the Negro children was 2.97 ($p < .01$); for the white children the t was 2.09 ($p < .05$).

These and similar data suggest that certain specific verbal repertoires were indeed influenced by the typewriter training. They also suggest that the Negro children profited from the training even though the Stanford-Binet and P.M.A. tests did not reveal it. This outcome suggests that modifications must be made in the testing as well as the training procedures.

CONCLUSIONS AND IMPLICATIONS

The reader at this point can probably supply only partial answers to the five questions posed in the section concerned with objectives. The reason for this is readily apparent. The answers are not simple but rather have to be qualified because the data which were collected raised almost as many questions as they answered. Therefore, it seems advisable at this time to take the answer to each question and examine it carefully.

1. Can Stanford-Binet I.Q.'s and patterns of abilities as measured by the P.M.A. test be changed by kindergarten experience?

The answer to this question is a qualified yes. It requires qualification because kindergarten experience significantly increased the Stanford-Binet I.Q.'s of the white children, but not those of the Negro children. In contrast, P.M.A. quotients of the Negro children, but not those of the white children, were significantly influenced by kindergarten experience.

2. Will programmed discriminative training given in conjunction with normal kindergarten experience produce greater changes in Stanford-Binet I.Q. and P.M.A. quotients than kindergarten experience alone?

Again the answer is a qualified yes. The matching-to-sample training of the first three years had no effect on any of the test scores of the white children. The typewriter training given during the fourth year, however, produced significantly greater increases in Stanford-Binet I.Q.'s and P.M.A. verbal quotients than did kindergarten experiences alone in the case of the white children. In contrast, the matching-to-sample training given during the first three years produced significantly greater increases in P.M.A. total, verbal, and number quotients in the case of the Negro children. It had no effect, however, on the Stanford-Binet I.Q.'s. In addition, the typewriter instruction which had been so helpful to the white children, had no significant effect on the Stanford-Binet and P.M.A. scores of the Negro children.

3. How persistent are the changes produced by kindergarten experience and by kindergarten experience plus the special instruction?

The significant gains produced in the white children by kindergarten experience during the preschool year were disappointingly short-lived, usually disappearing by the end of the first grade. More will be said about this later.

Only the typewriter instruction, which was given during this past year, significantly influenced the scores of the experimental white children. It is impossible at this time, therefore, to assess the persistence of gains produced in the white children by special instruction because none as yet have completed the first or second grades.

Kindergarten experience produced gains in the Negro children which appear to be more persistent than they were in the white children. Many gains, for example, were significant over the preschool year plus the first year in school. Closer inspection of the gains found in the Negro children who received only kindergarten experience, however, indicates that their gains in many instances were not significantly larger at the end of the first year in school than were those shown by the Negro children who did not attend kindergarten. Thus, much of the kindergarten - no-kindergarten difference was contributed by those Negro children who attended kindergarten and who in addition received the special programmed instruction.

The gains produced in the P.M.A. quotients of the Negro children by the special instruction are perhaps the most persistent gains found. In fact the differential gains produced by the special instruction in the P.M.A. total, verbal, and numerical quotients were greater over the kindergarten year plus the first year in school than they were over the kindergarten year when the training was given. The effects thus not only persisted but also augmented learning during the first grade with the result that more highly significant gains were found over the two-year period than over the one-year period.

4. Are the changes produced related to original levels of intellective functioning?

As was indicated earlier, when gains were analyzed in terms of original intellective level, those who were initially below the median of a particular test or subtest almost always gained significantly more than did those who were initially above. This, however, was anticipated on the basis of what is known about regression toward the mean and did not interest us greatly. Our principal interest was whether the special programmed instruction would have a greater differential effect on those above or those below the median of each test. Only one such interaction was found to be statistically significant. This was the levels by programmed-instruction interaction for P.M.A. total-quotient gains over the kindergarten year plus the first year in school. It was found with the Negro children but not with the white. Further analysis of these data indicated that a significant gain was made by those Negro children who were initially above the median but not by those who were below. It is our opinion that this finding must be considered tentative at this time. So many Negro children (approximately 50 *per cent*) had scores below the established norms that quotient gains for scores below the median might have been obscured, and the interaction might have resulted from this bias as a statistical artifact.

Two additional findings seem relevant. First, the significant gains produced during the first three years of research were produced exclusively with the Negro children. Typically, the Negro children scored lower initially than did the white children. It may well be that these gains were produced in the performance of Negro children and not in the white because of their initially lower scores and thus, their greater behavioral deficit. Secondly, significant gains were produced only in the white children during the fourth year of research when the typewriters were used. The typewriters and their programs perhaps required higher initial levels of intellective competence than did the matching-to-sample presenters and their programs. Thus the white children who scored higher initially (especially in the requisite verbal skills) than did the Negro children are those who were helped.

Obviously, the reasoning which accompanies the last two findings is speculative. Nevertheless, it does not seem unreasonable to expect that certain kinds of training will augment the performance of those who make high scores initially and that other types will assist those who make low scores.

5. Are the effects of kindergarten experience plus special programmed instruction sufficiently general in nature to influence later academic performance as reflected by school grades and by scores made on the Stanford Achievement Test?

The answer at this time must be no. The academic grades of those children who received programmed instruction were not significantly different from those who did not receive it. Similarly, those children who attended kindergarten (and who in some instances received special programmed instruction) did not score significantly higher on the Stanford Achievement Test than did those who did not attend kindergarten. As a matter of fact, those children who did not attend kindergarten scored significantly higher on the S.A.T. than did those who did attend. It seems sufficient to say at this point that neither academic grades nor S.A.T. scores were particularly sensitive and that other measures of academic achievement must be used in the future. The finding that the non-kindergarten children had S.A.T. scores which were significantly superior to those of the children who did attend kindergarten seems important enough to justify separate consideration, and it will be discussed shortly.

Although tentative answers were obtained to the five questions originally posed, four other important questions as yet remain unanswered. The first of these is concerned with the level of cultural deprivation of the children studied. If one were to base his answer to this question on Stanford-Binet I.Q.'s, one would have to say that most of the children were not more culturally deprived than children in general. This would follow from the fact that the initial mean Stanford-Binet I.Q. for the white children was approximately 99 and that of the Negro children was approximately 90. It should be noted that a score of 90 would have exceeded approximately 68 per cent of the sample of five-year old Negro children studied by Kennedy et al. (1963).

Other data, however, present quite a different picture. For example, in the case of the Negro children at the time of their first testing on the P.M.A., approximately 82 per cent scored at or below the first percentile (of the national norms), and approximately 95 per cent at or below the tenth percentile. The white children faired a little better. Approximately 25 per cent of them scored at or below the first percentile, and slightly more than 50 per cent scored at or below the tenth percentile. According to these data at least 80 per cent of the Negro children and 25 per cent of the white children might be considered culturally disadvantaged.

Other data relevant to the issue are the total family incomes and the educational levels of the parents. Drs. Earl Baughman and Grant Dahlstrom interviewed several hundred white and Negro families in northern Orange County in the course of obtaining data for their project. I am indebted to them for allowing me to use these data from their unpublished manuscript (1967).

In regard to family income, Baughman and Dahlstrom interviewed 110 white families and 90 Negro families. They found that approximately 15 _per cent_ of the white families had annual incomes under $2500, and 45 _per cent_ under $5000. The Negro families earned considerably less. Fifty-four _per cent_ earned less than $2500, and 92 _per cent_ less than $5000. A conservative estimate of the percentages who were culturally deprived, based on these data, would be 15 _per cent_ and 54 _per cent_, but a more realistic estimate would be 45 _per cent_ and 92 _per cent_.

Two hundred and ninety-nine white families and 324 Negro families were questioned in regard to parental education. An analysis of these data indicated that 31 _per cent_ of the white mothers and 44 _per cent_ of the white fathers had completed eight grades or less. Again the Negro families fared less well. Approximately, 49 _per cent_ of the Negro mothers and 61 _per cent_ of the Negro fathers had completed eight grades or less. Estimates here might range from 31 to 44 _per cent_ for the whites and from 49 to 61 _per cent_ for the Negroes.

All of these data suggest that some degree of cultural deprivation existed among both white and Negro children but that it was much more severe and widespread in the case of the Negro children than in the case of the white. This is of some significance in interpreting the data of the first three waves of children, i.e. those entering in 1962, in 1963, and in 1964. It will be recalled that the matching-to-sample training in conjunction with kindergarten experience produced significantly greater gains than kindergarten experience alone only in the case of the Negro children and only on the P.M.A. test. It may well be that such training is useful with just such a population and is of little value when levels of cultural deprivation are not so high.

The data obtained with 1965-66 procedures, i.e. with the typewriters, also can be accomodated to this hypothesis. Thus, the white children showed significant gains on the Stanford-Binet and on the P.M.A. verbal scale whereas the Negro children showed no significant gains. The white children began the year with a mean I.Q. of 101 as compared to one of approximately 91 for the Negro children. Mean P.M.A. verbal quotient scores were approximately 85 for the white children and 78 for the Negro children. These data suggest that a certain minimal level of competance is necessary for this technique (at least as it was used during the past year) to raise scores. In terms of future operating procedures these results indicate that the more culturally deprived, and thus the less able, children should be well trained with the matching-to-sample programs before they are trained on the typewriter. For those who score higher initially, however, the matching-to-sample training might be omitted, and the typewriter training started immediately.

A second question not originally posed but requiring discussion is one concerned with performance on the matching-to-sample programs and the relation of this performance to the test data. This question was not raised originally because of the fact that matching-to-sample programs do not ordinarily yield data which are open to overall analysis. This results from the fact that most programs are revised from time to time, thus precluding the combining of data over years. One program, however, was prepared during the first year, and it was used in its original form throughout the three-year period. This is a program designed to teach inductive reasoning. Because this program was unchanged, because it was typically the last program in the sequence of programs used each year, and because it generated errors in most subjects, we decided to analyze the data obtained with this program and to relate them to the test data.

The inductive program was composed of 237 slides, distributed equally in three trays of slides. In spite of the fact that the easiest discriminations were placed in the first tray, most of the errors occurred with the slides of that tray. Therefore, we decided to restrict our analysis to the performance data obtained with the first tray of inductive slides. Our criterion of successful performance on the first tray of slides was to complete the 79 discriminations with no more than five errors. Most subjects did not meet this criterion on the first trial, but approximately 55 _per cent_ of the white children did so by the second trial, and about an equal number of the Negro children did by the third. It was our belief that if performance on the programs in general and on this program in particular were related to test performance, there might well be significant differences between the test scores of those white children who reached the criterion in two or fewer trials and those who required three or more. We also believed that there might be similar differences between those Negro children who reached the criterion in three or fewer trials and those who required four or more.

In general, significant differences between the groups were found, but they were not as simple as had first been expected. In the case of the white children, that group which completed the first tray of inductive slides in two or fewer trials gained significantly more on the Stanford-Binet over the kindergarten year plus the first year in school than did the group which required three or more trials (13.90 _vs_ 8.00; $F = 5.54$; df = 1 and 34; $p < .05$). In addition, that group which required two or fewer trials had a significantly higher mean P.M.A. total quotient score at the fall testing of the kindergarten year than that group which required three or more (83.24 _vs_ 66.27; $F = 9.43$; df = 1 and 34; $p < .01$). In the case of the Negro children, no Stanford-Binet differences were found. That group reaching the criterion in three or fewer trials, however, gained more P.M.A. total quotient points over the kindergarten year than did that group which required four or more (23.89 _vs_ 14.44; $F = 7.38$; df = 1 and 32; $p < .05$).

These data indicate that performance on the programs is related to performance on the tests. Thus, in the case of the white children, those who successfully completed the 79 discriminations in two or fewer trials scored significantly higher on the first P.M.A. test than did those who required more trials. The data also suggest that gains on the tests are related to performance on the programs. This suggestion is supported by two findings: (1) those white children who reached the criterion in two or fewer trials showed a significantly greater gain on the Stanford-Binet over the kindergarten year plus the first year in school than did those white children who performed less well, and (2) those Negro children who reached the criterion in three or fewer trials gained significantly more P.M.A. total quotient points over the kindergarten year than did those who performed less well.

One final implication of the data not yet discussed is that there is some evidence that exposure to the programs may result in delayed gains even though performance on the programs is not good. Thus, in the case of the Negro children, that group which performed well on the program gained significantly more on the P.M.A. over the kindergarten year than did that group which performed less well (23.89 _vs_ 14.44). The gain of 14.44 P.M.A. total quotient points made by the poorer performers was not significantly different from the gain of 14.51 points made by the Negro kindergarten children who did not receive programmed instruction. Over the kindergarten year plus the first year in school, however, both the good and the poor performers on the program gained essentially the same amount (33.72 _vs_ 32.50). Thus, those who performed well showed earlier gains while those who had performed less well showed later gains, and both groups showed significantly greater gains over the kindergarten year plus the first year in school than did those Negro kindergarten children who did not receive the special programmed instruction (33.72 _vs_ 32.50 _vs_ 26.56).

A third question raised by the data is one concerned with the evaluative procedures. Until the fourth year of research we had been unable to influence significantly the Stanford-Binet I.Q.'s by means of our special instruction. We had influenced, however, the P.M.A. quotients. During the fourth year we significantly influenced both the Stanford-Binet I.Q.'s and quotients on one P.M.A. subtest, namely the verbal subtest. This suggests that the Stanford-Binet test at the fifth through the eighth-year levels is sensitive to changes in verbal skills but not particularly sensitive to changes in perceptual, spatial, and numerical skills. The P.M.A. test, on the other hand, seems sensitive to changes in all of these, especially if the initial levels of performance are relatively low.

In addition, various tests, because of their format, mode of presentation, or motivational demands, seem differentially sensitive at various mental age levels. The Stanford-Binet requires responses which emphasize construction or composition. On the other hand the P.M.A. for grades K - 1 places greater emphasis on simpler recognitive and matching-type skills. It may well be that for the Negro children, whose mental ages were typically lower, the Stanford-Binet constituted a test which was insensitive to gains whereas the P.M.A. is one which was sensitive. The converse, however, may be true for the white children. Thus, at the mental age-levels at which we were working, the Stanford-Binet may have been the appropriate test for the white children, while the P.M.A. may have been non-discriminating.

At other mental age-levels, especially where there is not such a marked change from perceptual-motor to verbal skills, the Stanford-Binet may be equally sensitive for both Negro and white children. In this regard it should be noted that the P.M.A. for grades 2-4 became much more difficult and thus less sensitive for the Negro children than the P.M.A. for grades K-1 had been. In almost every instance Negro children showed decreases in P.M.A. quotients when they were tested for the first (and only) time with the 2-4 version. A part of this loss almost certainly resulted from the loss of accumulated practice effects on the K-1 version. A greater part, in our opinion, was due to the sudden increase in difficulty. A better research instrument might have been a composite of the K-1 and 2-4 versions.

During the fourth year the Negro children showed significant gains on neither of the standardized tests, i.e., on neither the Stanford-Binet nor the P.M.A. They did show gains, however, on a number of specific achievement tests designed to assess the effects of particular programs. These later data, thus, indicate that the typewriter training did indeed have a salutory effect on the behavioral or cognitive development of the Negro children. Admittedly, the effects seem highly specific, but this may well be due to the fact that our achievement tests did not cover a broad enough spectrum of specific skills. Had they been more broadly conceived and covered a wider range of related verbal skills, the effects of the training might have proven to be more general. At the same time it must be admitted that the training procedures as well as the achievement tests probably need to be changed in order to gain more general effects.

A major implication of this line of reasoning is that more attention should be paid to the precise specification of the behavioral goals of the training. In the past the behavioral goals of such research have been to produce increases in scores on standardized tests such as the Stanford-Binet and P.M.A. Although useful, tests of this kind give rather gross pictures of the behaviors which are being changed. Achievement tests are required which yield more detailed information about the changes of particular behaviors. Future research on the project will not exclude the more general standardized tests, but efforts will be directed toward the development and use of specific achievement tests which yield more detailed pictures of the behavioral changes produced by the interventional procedures.

A fourth question raised by the analyses is whether or not the reversed effects found sometimes at the end of the first year in school, but more often at the end of the second, are related to kindergarten experience. One possible answer is that they are and that kindergarten experience actually interfered with later academic achievement in school. Unfortunately, data are not available to refute completely this hypothesis. It seems improbable, however, on other grounds.

The differential gains shown originally by the kindergarten children were probably due to the operation of a number of variables. Part of the gain almost certainly resulted from the experiences afforded the kindergarten children. Another major part, however, must have been due to increased rapport on the part of the children with the examiners and to favorable biases on the part of examiners and teachers toward the children who had attended kindergarten. One might expect the effects due to differential rapport and examiner bias to disappear once all children had attended school for a time. One might also expect the effects of kindergarten experience to be lost in the first or second grade if instruction were uniformly poor and reinforcement infrequent. On the other hand, one would certainly not expect the reversed effect unless some additional variables were introduced and allowed to operate differentially. It is my hypothesis that this is what happened.

Thus, in the first and second grades of the two schools where the kindergartens were located, instruction and motivation were noticeably inferior to that at the other two schools, i.e. at the non-kindergarten schools. This observation was made both by members of this project and by those working on the Baughman-Dahlstrom project as well. The effects of these differences are reflected not only in the reversed gains on the Stanford-Binet and P.M.A. tests but also by the significantly superior scores on the Stanford Achievement Test made in the first and second grades by the non-kindergarten children.

The implications of these effects are important. First of all, they emphasize the difficulties inherent in assessing the longitudinal effects of various kinds of preschool training. Secondly, they raise the practical question as to fruitfulness of giving preschool training without also upgrading instruction and motivation in all school grades. Clearly kindergarten experience and special instruction are helpful in raising intellective levels. Our test data show this. Therefore, the new emphasis on preschool experience should not be given up. It cannot take the place of good first and second grade instruction, however, and additional emphasis must also be placed there.

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